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EXAMINER	
PROCTOR, JASON SCOTT	

ART UNIT	PAPER NUMBER
2123	

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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/046,715	ANAMI ET AL.	
	Examiner	Art Unit	
	JASON PROCTOR	2123	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *02 March 2011*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1,2 and 5-22* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1,2 and 5-22* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

5) ☐ Notice of Informal Patent Application

6) ☐ Other: _____.

DETAILED ACTION

Claims 1-2 and 5-22 were rejected in the Office Action entered on 3 December 2010.

A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 3 February 2011 has been entered.

The 3 February 2011 submission has amended claims 1, 2, 7, 9, 11-15, 17-20, and 22. Claims 1-2 and 5-22 are pending in this application.

Claims 1-2 and 5-22 are rejected.

Response to Remarks - Claim Objections

1. In response to the claim amendments, the previous objection to claim 13 is withdrawn.

Response to Remarks - 35 USC § 103

2. In response to the previous rejection of claims 1, 2, and 5-21 under 35 U.S.C. § 103(a) as being unpatentable over Sebastian in view of Shebini, and Barequet, Applicants argue primarily that:

> The Office Action, at page 5, asserts that "the independent claims recite which errors are identified, and by not describing the error identifying algorithm, it is clear that according to the basic principles of claim construction, the invention is not limited to any particular type of error identifying algorithm." Applicants respectfully disagree. Amended claim 1 recites "creat[ing] a corresponding surface group in accordance with user input of a correspondence between the part shape models corresponding to the respective selected

> unit work history data; [and] determin[ing], using the corresponding surface group, errors in the combined shape model arising from the second reference surface." Amended claims 2, 7, 9, 11-15, and 17-20 recite similar subject matter. Thus, the independent claims recite an error identifying algorithm that relies on the use of a corresponding surface group created "in accordance with user input of a correspondence between the part shape models corresponding to the respective selected unit work history data."

The Examiner respectfully responds as follows.

The Examiner has considered every word of the claim language. However, nowhere does claim 22 recite an **algorithm**, let alone an **algorithm for detecting errors**. Instead, the claim generically recites, inter alia:

> "determine, using the corresponding surface group, the errors in the combined shape model arising from the second reference surface […]
> wherein the errors determined using the corresponding surface group include at least one of a change of a number of configuring surfaces, a change in direction or quantity of border lines, reversal of a direction of a surface, and folding of a surface."

As previously suggested, the claim language merely describes **which errors are identified** but does not limit the **method** or **algorithm** for "determining, using the corresponding surface group, the errors in the combined shape model arising from the second reference surface".

Applicants further refer to the claim language:

> "create a corresponding surface group in accordance with user input of a correspondence between the part shape models corresponding to the respective selected unit work history data;"

and suggest that this language further limits "an error identifying algorithm". However, the Examiner respectfully submits that this language describes the corresponding surface group that is vaguely "used" to "determine … the errors". This description is insufficient to particularly point out and distinctly claim any specific features of "an error identifying algorithm" or even the claimed step of "determin[ing] … the errors".

Therefore, the claim language neither recites nor implies any limitations regarding an "algorithm for detecting errors" nor a method for "determining" beyond the ordinary meaning of the claim language. The invention broadly and generically "uses" the "corresponding surface group" to "determine … the errors" recited by the claim.

Further, the prior art teaches these claimed features. The rejection is based upon a combination of Sebastian, Shebini, and Barequet, as set forth in the previous Office Action.

To paraphrase the claim rejection shown below, Sebastian teaches combining at least two selected work history data and output design work data for creating a combined shape model [See, e.g., (Sebastian, column 12, lines 3-25) describing "feature templates" which correspond to the claimed "work history data"; and (Sebastian, column 23, lines 9-22) describing "macro-features" and "macro-feature templates" which correspond to the claimed "combined shape model"]

the combined shape model comprising a second reference surface [See, e.g., (Sebastian, column 23, lines 9-22) describing the assembly of feature templates into a "macro-feature", and the macro-feature itself being a "feature" in the CAD system. Sebastian teaches that features comprise a reference surface (See, e.g., Sebastian, column 11, lines 32-49) and consequently the creation of a "macro-feature" from a combination of sub-features comprises the creation of a "second reference surface"].

Sebastian teaches that the second reference surface is formed by sequentially reproducing the selected unit work history data one by one and joining part shape models corresponding to the respective selected unit work history data [See, e.g., (Sebastian, FIGS. 2A-2B) depicting a

diagrammatic representation of an example feature template, and (Sebastian, column 12, lines 39 et seq.) describing how the example feature template is constructed. Further, (Sebastian, column 23, lines 9-22) describes how feature templates may be combined to form macro feature templates. That is, the selected individual work history data ("feature templates") are sequentially reproduced, one by one (i.e. processing a "macro feature templates"), and their respective part shape models ("features") are joined to produce a combined shape model ("macro features" resulting from processing a "macro feature template")].

Sebastian teaches to create a corresponding surface group ("macro feature") in accordance with user input ("macro feature templates") of a correspondence between the part shape models ("features") corresponding to the respective selected unit work history data ("feature templates") [(Sebastian, column 12, lines 3-25); (Sebastian, column 23, lines 9-22)].

Applicant's arguments have been fully considered but have been found unpersuasive.

3. Applicants further argue on page 25 of the response that:

> The Office Action, at page 19, cites column 11, line 55, through column 12, line 11 of Sebastian as allegedly disclosing "creat[ing] a corresponding surface group" and column 22, lines 21-65, of Sebastian as allegedly disclosing "determin[ing], using the corresponding surface group, errors in the combined shape model arising from the second reference surface." Column 11, line 55, through column 12, line 11 of Sebastian, however, merely discloses the hierarchical structure of the templates of Sebastian, and is silent regarding "creat[ing] a corresponding surface group in accordance with user input of a correspondence between the part shape models corresponding to the respective selected unit work history data." The Office Action fails to articulate how this section of Sebastian purportedly provides any disclosure of the creation of a corresponding surface group. Column 22, lines 21-65 of Sebastian disclose only an error based on "the thickness exceed[ing] the manufacturer's recommendation," Sebastian col. 22, lines 37-38, and not "determin[ing], using the corresponding surface group, errors in the combined shape model arising from the second reference surface." Thus, Sebastian does not disclose or suggest either the creation of a corresponding surface group as claimed, or the use of such a corresponding group to determine errors in a combined shape model.

The Examiner apologizes for any confusion resulting from the previous Office Action. The description of the prior art shown above is believed to clarify the Examiner's position, as requested.

4. Applicants further argue on page 26 of the response that:

> The Office Action, at pages 9-12, asserts that Sebastian, at col. 12, lines 39-57 and Figs. 2A and 2B, "clearly teaches forming a 'combined shape model' by joining part shape models corresponding to the respective selected work history data." The Office Action at page 12 further describes the teaching of Sebastian as follows: "The definition of the Plastic_Molded_Box_System comprises a sequence of feature templates, each feature template representing stored 'unit work history data,' and some of the feature templates representing 'part shape models corresponding to the respective selected work history data." Thus, as Office Action describes, Sebastian teaches a sequence of whole feature templates. In contrast, amended claim 1 recites that the data of a selected unit work history are sequentially reproduced, one by one, and not as an entire unit, as the Office Action alleges the disclosure of Sebastian to teach. Sebastian does not disclose or suggest sequentially reproducing unit work history data one by one. Shebini and Barequet also do not disclose or suggest this feature.

The Examiner respectfully traverses this argument as follows.

The Examiner respectfully disagrees that Sebastian teaches reproducing the work history "as an entire unit" in contrast to "sequentially … one by one" according to the claim language. In fact, Sebastian expressly provides an example of the feature templates being used to construct an assembly (Sebastian, column 20, line 63 - column 23, line 8). It is unclear where Applicants find support in Sebastian for the conclusion that Sebastian reproduces work history "as an entire unit".

Applicant's arguments have been fully considered but have been found unpersuasive.

Applicants submit similar remarks for the other independent and dependent claims. These arguments have been fully considered but are traversed as shown above.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. § 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

The factual inquiries set forth in Graham **v.** John Deere Co., 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. § 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. § 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. § 103(c) and potential 35 U.S.C. § 102(e), (f) or (g) prior art under 35 U.S.C. § 103(a).

5. Claim 22 is rejected under 35 U.S.C. § 103(a) as being unpatentable over US Patent No. 5,552,995 to Sebastian in view of "Repairing CAD Models" by Gill Barequet et al. ("Barequet").

Regarding claim 22, Sebastian teaches a design support system [(abstract); *"...the present invention is implemented in the 'C++' programming languag*e and uses Pro-Engineer from Parametric Technology Inc. as its solid modeling and front-*end CAD system."* (column 11, lines 21-26); *"The present invention enables a designer to create feature templates and store* them in a feature template library." (column 13, lines 44-46)], comprising:

a database (FIG. 2, reference 34) which divides a history of design work for creating a shape model, comprising a first reference surface, for each part of the shape model and holds a plurality of design work histories as unit work history data [*"The template scheme provides a* uniform data handling mechanism that spans the domain of part, tooling, process and material. The templates of the present invention allow the collection, under a single header, of various types of information: fixed parameters (e.g., user supplied data), parameters derived by *relationship with other parameters from the same template (e.g., a boss' outer diameter* computed from the value of its own inner diameter), parameters derived by relationship with *parameters from other templates in the same domain (e.g., a boss' height computed from the* thickness of the wall to which it is attached), and parameters derived by relationship with *parameters from other templates in other domains (e.g., a boss' draft ang*le computed from the *tool orientation relative to the boss)."* (column 11, lines 32-49)]; and

a control section configured to:

fetch at least two unit work history data selected from the plurality of unit work history data held by the database [*"An example of a feature template is a "support::tapered wall" feature template, wherein the primitive object is a tapered wall and the function of the tapered wall is support. Another example is a "support::rib" feature template that represents a* type of projection known as a rib, where the rib has a support function. A tapered wall and a rib can be regarded as sub-*parts that can be used to make a part."* (column 12, lines 3-25); i.e., "feature templates" correspond to the claimed "work history data"; and (Sebastian, column 23, lines 9-22) describing "macro-features" and "macro-feature templates" which correspond to the claimed "combined shape model"];

combine at least two selected work history data and output design work data for creating a combined shape model [See, e.g., (Sebastian, column 12, lines 3-25) describing "feature templates" which correspond to the claimed "work history data"; and (Sebastian, column 23, lines 9-22) describing "macro-features" and "macro-feature templates" which correspond to the claimed "combined shape model"]

the combined shape model comprising a second reference surface [See, e.g., (Sebastian, column 23, lines 9-22) describing the assembly of feature templates into a "macro-feature", and the macro-feature itself being a "feature" in the CAD system. Sebastian teaches that features comprise a reference surface (See, e.g., Sebastian, column 11, lines 32-49) and consequently the creation of a "macro-feature" from a combination of sub-features comprises the creation of a "second reference surface"];

the second reference surface is formed by sequentially reproducing the selected unit work history data one by one and joining part shape models corresponding to the respective selected

unit work history data [See, e.g., (Sebastian, FIGS. 2A-2B) depicting a diagrammatic representation of an example feature template, and (Sebastian, column 12, lines 39 et seq.) describing how the example feature template is constructed. Further, (Sebastian, column 23, lines 9-22) describes how feature templates may be combined to form macro feature templates. Sebastian provides an example of the feature templates being used sequentially, one by one, to construct an assembly (Sebastian, column 20, line 63 - column 23, line 8). That is, the selected individual work history data ("feature templates") are sequentially reproduced, one by one (i.e. processing a "macro feature templates"), and their respective part shape models ("features") are joined to produce a combined shape model ("macro features" resulting from processing a "macro feature template")].

Sebastian teaches to create a corresponding surface group ("macro feature") in accordance with user input ("macro feature templates") of a correspondence between the part shape models ("features") corresponding to the respective selected unit work history data ("feature templates") [(Sebastian, column 12, lines 3-25); (Sebastian, column 23, lines 9-22)].

Sebastian teaches to determine, using the corresponding surface group, errors in the combined shape model arising from the second reference surface [See column 22, et seq., in particular: "The designer starts by instantiating the nominal wall feature and uses the add-on operation to provide "Fasten" functionality. In this example, the system searches for a function template using "Fasten" as the search criteria and provides the user with the boss feature. The user specifies the parameters for the boss such as dimension and positioning information. Based on the selection, the reasoning attributes of the feature template are evaluated and the system examines the appropriate constraints. The constraints retrieve necessary additionally

information from other feature templates, look-up tables and the material database 90. The constraints that pertain to the feature "boss" are evaluated, and it is found that the thickness of the boss is adequate to support the applied load. However, while considering the mold fill criteria, the thickness exceeds the manufacturer's recommendation (as retrieved from the manufacturer's external database) for the selected material. Depending on the constraint evaluation results, the user is notified through one of the following mechanisms: warning *messages, error messages and design change recommendations... In the boss example, the* system notifies the user that the "BOSS IS TOO THICK" and recommends a range of appropriate thickness values for the selected material that satisfies both the mold fill and the strength criteria." (column 22, line 18, et seq.)].

Sebastian does not expressly teach that the errors determined using the corresponding surface group include at least one of a change of a number of configuring surfaces, a change in direction or quantity of border lines, reversal of a direction of a surface, and folding of a surface.

Barequet teaches determining errors using a corresponding surface group, the errors including at least one of a change of a number of configuring surfaces, a change in direction or quantity of border lines, reversal of a direction of a surface, and a folding of a surface ["We describe an algorithm for repairing polyhedral CAD models that have errors in their B-REP. Errors like cracks, degeneracies, duplication, holes and overlaps are usually introduced in solid models due to imprecise arithmetic, model transformations, designer's fault, programming bugs, etc." (Barequet, abstract); "If the original orientation of facets is not consistent, we need to make the following modifications to our algorithm: Orient all the facets of each connected component consistently with re*spect to other facets in the component..."* (Barequet, page 366, "4.2

Orientation Checking"); "The algorithm is also able to detect non-orientable surfaces while processing a "back-edge" in the depth-first order traversal. Back-edges are used to perform a consistency check between two facets whose respective orientations are already fixed. If the two orientation do not match, the component is non-orientable and the system reports the error as such." (Barequet, page 365, "2 Computing the Connected Components")].

Sebastian and Barequet are analogous art because both are directed to CAD modeling.

It would have been obvious to a person of ordinary skill in the art at the time of Applicants' invention to combine the teachings of Sebastian with Barequet as expressly motivated by Barequet to identify and correct problems in the CAD model ["File formats like *IGES ... DXF ... and STL ... (which is a de facto standard in the rapid*-prototyping industry) allow users to represent models as such soups of polygons... The collection of polygons is assumed to represent a complete model. Unfortunately this is often not the case. Typical problems include cracks (in the surface), degeneracies, duplication (of patches of the surface), *holes and overlaps, as shown in Figure 1... We presen*t algorithms to eliminate dangling geometry, T-joins, holes and cracks in a polygonal solid model, and generate consistent polygon-orientations." (Barequet, page 363, "1 Introduction")]. The combination could be achieved by using Barequet's algorithms in the system and method described by Sebastian to identify and correct the same types of errors in Sebastian's CAD models. The combination would produce a system as described by Sebastian but enhanced with the error identification and correction techniques taught by Barequet.

Therefore it would have been obvious to a person of ordinary skill in the art at the time of Applicants' invention to combine the teachings of Sebastian with Barequet to arrive at the invention specified in claim 22.

6. Claims 1-2 and 5-21 are rejected under 35 U.S.C. § 103(a) as being unpatentable over US Patent No. 5,552,995 to Sebastian in view of US Patent No. 4,858,146 to Shebini, further in view of "Repairing CAD Models" by Gill Barequet et al. ("Barequet").

Regarding claim 1, Sebastian teaches:

A design support system [(abstract); *"...the present invention is implemented in the 'C++' programming language and uses Pro-*Engineer from Parametric Technology Inc. as its solid modeling and front-*end CAD system."* (column 11, lines 21-26); *"The* present invention enables a designer to create feature templates and store them in a feature template library." (column 13, lines 44-46)], comprising:

database (FIG. 2, reference 34) which divides a history of design work for creating a shape model, comprising a first reference surface, for each part of the shape model and holds a plurality of design work histories as unit work history data [*"The template scheme provides a* uniform data handling mechanism that spans the domain of part, tooling, process and material. The templates of the present invention allow the collection, under a single header, of various types of information: fixed parameters (e.g., user supplied data), parameters derived by relationship with other parameters from the same template (e.*g., a boss' outer diameter* computed from the value of its own inner diameter), parameters derived by relationship with *parameters from other templates in the same domain (e.g., a boss' height computed from the*

thickness of the wall to which it is attached), and parameters derived by relationship with *parameters from other templates in other domains (e.g., a boss' draft angle computed from the tool orientation relative to the boss).*" (column 11, lines 32-49)]; and

a control section configured to fetch at least two unit work history data selected from the plurality of unit work history data held by the database [*"An example of a feature template is a "support::tapered wall" feature template, wherein the primitive object is a tapered wall and the* function of th*e tapered wall is support. Another example is a "support::rib" feature template* that represents a type of projection known as a rib, where the rib has a support function. A tapered wall and a rib can be regarded as sub-parts that can be used to make a pa*rt.*" (column 12, lines 3-11)]; and

combine at least two selected work history data and output design work data for creating a combined shape model [See, e.g., (Sebastian, column 12, lines 3-25) describing "feature templates" which correspond to the claimed "work history data"; and (Sebastian, column 23, lines 9-22) describing "macro-features" and "macro-feature templates" which correspond to the claimed "combined shape model"]

the combined shape model comprising a second reference surface [See, e.g., (Sebastian, column 23, lines 9-22) describing the assembly of feature templates into a "macro-feature", and the macro-feature itself being a "feature" in the CAD system. Sebastian teaches that features comprise a reference surface (See, e.g., Sebastian, column 11, lines 32-49) and consequently the creation of a "macro-feature" from a combination of sub-features comprises the creation of a "second reference surface"];

the second reference surface is formed by sequentially reproducing the selected unit work history data one by one and joining part shape models corresponding to the respective selected unit work history data [See, e.g., (Sebastian, FIGS. 2A-2B) depicting a diagrammatic representation of an example feature template, and (Sebastian, column 12, lines 39 et seq.) describing how the example feature template is constructed. Further, (Sebastian, column 23, lines 9-22) describes how feature templates may be combined to form macro feature templates. Sebastian provides an example of the feature templates being used sequentially, one by one, to construct an assembly (Sebastian, column 20, line 63 - column 23, line 8). That is, the selected individual work history data ("feature templates") are sequentially reproduced, one by one (i.e. processing a "macro feature templates"), and their respective part shape models ("features") are joined to produce a combined shape model ("macro features" resulting from processing a "macro feature template")].

Sebastian teaches to create a corresponding surface group ("macro feature") in accordance with user input ("macro feature templates") of a correspondence between the part shape models ("features") corresponding to the respective selected unit work history data ("feature templates") [(Sebastian, column 12, lines 3-25); (Sebastian, column 23, lines 9-22)].

Sebastian teaches to determine, using the corresponding surface group, errors in the combined shape model arising from the second reference surface [See column 22, et seq., in particular: "The designer starts by instantiating the nominal wall feature and uses the add-on operation to provide "Fasten" functionality. In this example, the system searches for a function template using "Fasten" as the search criteria and provides the user with the boss feature. The user specifies the parameters for the boss such as dimension and positioning information. Based

on the selection, the reasoning attributes of the feature template are evaluated and the system examines the appropriate constraints. The constraints retrieve necessary additionally information from other feature templates, look-up tables and the material database 90. The constraints that pertain to the feature "boss" are evaluated, and it is found that the thickness of the boss is adequate to support the applied load. However, while considering the mold fill criteria, the thickness exceeds the manufacturer's recommendation (as retrieved from the manufacturer's external database) for the selected material. Depending on the constraint evaluation results, the user is notified through one of the following mechanisms: warning *messages, error messages and design change recommendations... In the boss example, the* system notifies the user that the "BOSS IS TOO THICK" and recommends a range of appropriate thickness values for the selected material that satisfies both the mold fill and the strength criteria." (column 22, line 18, et seq.)].

Sebastian does not expressly teach a database accumulating technical conditions as claimed, or that the errors determined using the corresponding surface group include the types recited by the claim.

Shebini teaches a database accumulating technical conditions, which are to be met by a part shape model to be created according to each unit work history data, in association with each unit work history data ["Turning to very particular structures, namely off-shore platforms, we see that they must be structurally adequate for operational and environmental loading, practical to construct, and be cost effective. The selection of a configuration is based on functional requirements and methods of installation." (Shebini, column 3, lines 60-65); "Once environmental loads are determined, they are combined with operational loads, and an estimate

is made of the resulting pile mudline moments and axial forces." (Shebini, column 4, lines 33-39); "Before the design solution of either the 3-dimensional "finite Element" analysis of the superstructure and jacket, or the beam-column analysis of the piling can be considered finished, it is necessary to determine compatible conditions at the pilehead-structure interface. These equilibrium conditions are usually obtained using an interaction analysis procedure which yields the combined response of the linear structure and its non-linear soil-pile foundation for nay imposed static load condition." (Shebini, column 4, lines 55-65); et cetera. Shebini provides numerous examples of the "technical conditions" that are accumulated in columns 3 and 4]; and

computing at least one technical characteristic value of the combined shape model which is created from the output design work data ["The equilibrium conditions determined from the interaction analysis are now imposed on the structural Model in combination with appropriate design loads, and a static analysis is performed. The internal member forces determined in this analysis are employed to check the stress levels in the members." (Shebini, column 4, line 65 - column 5, line 2)]; and

comparing the computed technical characteristic value with the technical conditions related to unit work history data which is the origin of the design work data ["The stresses are compared to allowable stresses, as set forth in the design basis, and members resized accordingly." (Shebini, column 5, lines 2-5)];

wherein the computation of the at least one technical characteristic value comprises analyzing the strength of the combined shape model ["stress levels in the members" (Shebini, column 4, line 65 - column 5, line 5)].

Sebastian and Shebini are analogous art because both are drawn to structural modeling.

It would have been obvious to a person of ordinary skill in the art at the time of Applicants' invention to combine the teachings of Sebastian and Shebini as expressly motivated by Shebini in order to predict the structural properties of the assembled product ["Nowadays, by using the Finite Element Method (FEM), stress analysts do not have to modify the problem to conform to available solutions. No matter how complex the shape or system of loads may be, the (FEM) treats a loaded structure as being built of numerous tiny connected substructures or elements as are shown in FIG. 8. Since these elements can be put together in virtually any fashion, they can be arranged in simulate exceedingly complex shapes. Thus, the (FEM) can be used to determine stresses for structural parts where no mathematically closed form solution exists." (Shebini, column 1, lines 25-35)]. The combination could be achieved by using Shebini's structural analysis method to analyze the model described by Sebastian.

Sebastian in view of Shebini does not expressly teach that the errors determined using the corresponding surface group include at least one of a change of a number of configuring surfaces, a change in direction or quantity of border lines, reversal of a direction of a surface, and folding of a surface.

Barequet teaches determining errors using a corresponding surface group, the errors including at least one of a change of a number of configuring surfaces, a change in direction or quantity of border lines, reversal of a direction of a surface, and a folding of a surface ["We describe an algorithm for repairing polyhedral CAD models that have errors in their B-REP. Errors like cracks, degeneracies, duplication, holes and overlaps are usually introduced in solid models due to imprecise arithmetic, model transformations, designer's fault, programming bugs, etc." (Barequet, abstract); "If the original orientation of facets is not consistent, we need to make

the following modifications to our algorithm: Orient all the facets of each connected component *consistently with respect to other facets in the component..."* (Barequet, page 366, "4.2 Orientation Checking"); "The algorithm is also able to detect non-orientable surfaces while processing a "back-edge" in the depth-first order traversal. Back-edges are used to perform a consistency check between two facets whose respective orientations are already fixed. If the two orientation do not match, the component is non-orientable and the system reports the error as such." (Barequet, page 365, "2 Computing the Connected Components")].

Sebastian in view of Shebini and Barequet are analogous art because both are directed to CAD modeling.

It would have been obvious to a person of ordinary skill in the art at the time of Applicants' invention to combine the teachings of Sebastian in view of Shebini with Barequet as expressly motivated by Barequet to identify and correct problems in the CAD model ["File *formats like IGES ... DXF ... and STL ... (which is a de facto standard in the rapid*-prototyping industry) allow users to represent models as such soups of polygons... The collection of polygons is assumed to represent a complete model. Unfortunately this is often not the case. Typical problems include cracks (in the surface), degeneracies, duplication (of patches of the surface), *holes and overlaps, as shown in Figure 1... We present algorithms to eliminate dangling* geometry, T-joins, holes and cracks in a polygonal solid model, and generate consistent polygon-orientations." (Barequet, page 363, "1 Introduction")]. The combination could be achieved by using Barequet's algorithms in the system and method described by Sebastian in view of Shebini to identify and correct the same types of errors in Sebastian's CAD models. The combination

would produce a system as described by Sebastian in view of Shebini but enhanced with the error identification and correction techniques taught by Barequet.

Therefore it would have been obvious to a person of ordinary skill in the art at the time of Applicants' invention to combine the teachings of Sebastian, Shebini, and Barequet to arrive at the invention specified in claim 1.

Regarding claim 2, Sebastian teaches:

A design support system which outputs work data for creating a shape model, comprising a first reference surface, of a design target in order to create the shape model of the design target conforming to a standard shape [(abstract); (column 11, lines 32-49)], comprising:

A database which holds a plurality of unit work history data which are obtained by dividing a history of a design work performed with reference to a first standard shape for each design work history corresponding to a shape model of a predetermined portion (column 11, lines 32-49);

A control section configured to receive designation of data about a second standard shape (FIG. 2, reference 35);

Fetch multiple unit work history data selected from the multiple unit work history data held by the database (column 12, lines 3-11); and

combine each of the fetched unit work history data, sequentially reproduce unit work history data one by one, reproduce design work with reference to the designated second standard shape for the design works performed with reference to the first standard shape among the design works contained in the unit work history data [See, e.g., (Sebastian, column 12, lines 3-25)

describing "feature templates" which correspond to the claimed "work history data"; and (Sebastian, column 23, lines 9-22) describing "macro-features" and "macro-feature templates" which correspond to the claimed "combined shape model"; See, e.g., (Sebastian, FIGS. 2A-2B) depicting a diagrammatic representation of an example feature template, and (Sebastian, column 12, lines 39 et seq.) describing how the example feature template is constructed. Further, (Sebastian, column 23, lines 9-22) describes how feature templates may be combined to form macro feature templates. Sebastian provides an example of the feature templates being used sequentially, one by one, to construct an assembly (Sebastian, column 20, line 63 - column 23, line 8). That is, the selected individual work history data ("feature templates") are sequentially reproduced, one by one (i.e. processing a "macro feature templates"), and their respective part shape models ("features") are joined to produce a combined shape model ("macro features" resulting from processing a "macro feature template")];

the combined shape model comprising a second reference surface conforming to the second standard shape [See, e.g., (Sebastian, column 23, lines 9-22) describing the assembly of feature templates into a "macro-feature", and the macro-feature itself being a "feature" in the CAD system. Sebastian teaches that features comprise a reference surface (See, e.g., Sebastian, column 11, lines 32-49) and consequently the creation of a "macro-feature" from a combination of sub-features comprises the creation of a "second reference surface"];

Sebastian teaches to create a corresponding surface group ("macro feature") in accordance with user input ("macro feature templates") of a correspondence between the part shape models ("features") corresponding to the respective selected unit work history data ("feature templates") [(Sebastian, column 12, lines 3-25); (Sebastian, column 23, lines 9-22)].

Sebastian teaches to determine, using the corresponding surface group, errors in the combined shape model arising from the second reference surface [See column 22, et seq., in particular: "The designer starts by instantiating the nominal wall feature and uses the add-on operation to provide "Fasten" functionality. In this example, the system searches for a function template using "Fasten" as the search criteria and provides the user with the boss feature. The user specifies the parameters for the boss such as dimension and positioning information. Based on the selection, the reasoning attributes of the feature template are evaluated and the system examines the appropriate constraints. The constraints retrieve necessary additionally information from other feature templates, look-up tables and the material database 90. The constraints that pertain to the feature "boss" are evaluated, and it is found that the thickness of the boss is adequate to support the applied load. However, while considering the mold fill criteria, the thickness exceeds the manufacturer's recommendation (as retrieved from the manufacturer's external database) for the selected material. Depending on the constraint evaluation results, the user is notified through one of the following mechanisms: warning messages, error messages and design change recommendations… In the boss example, the system notifies the user that the "BOSS IS TOO THICK" and recommends a range of appropriate thickness values for the selected material that satisfies both the mold fill and the strength criteria." (column 22, line 18, et seq.)]. combine at least two selected work history data and output design work data for creating a combined shape model [See, e.g., (Sebastian, column 12, lines 3-25) describing "feature templates" which correspond to the claimed "work history data"; and (Sebastian, column 23, lines 9-22) describing "macro-features" and "macro-feature templates" which correspond to the claimed "combined shape model"]

the combined shape model comprising a second reference surface [See, e.g., (Sebastian, column 23, lines 9-22) describing the assembly of feature templates into a "macro-feature", and the macro-feature itself being a "feature" in the CAD system. Sebastian teaches that features comprise a reference surface (See, e.g., Sebastian, column 11, lines 32-49) and consequently the creation of a "macro-feature" from a combination of sub-features comprises the creation of a "second reference surface"];

the second reference surface is formed by sequentially reproducing the selected unit work history data one by one and joining part shape models corresponding to the respective selected unit work history data [See, e.g., (Sebastian, FIGS. 2A-2B) depicting a diagrammatic representation of an example feature template, and (Sebastian, column 12, lines 39 et seq.) describing how the example feature template is constructed. Further, (Sebastian, column 23, lines 9-22) describes how feature templates may be combined to form macro feature templates. Sebastian provides an example of the feature templates being used sequentially, one by one, to construct an assembly (Sebastian, column 20, line 63 - column 23, line 8). That is, the selected individual work history data ("feature templates") are sequentially reproduced, one by one (i.e. processing a "macro feature templates"), and their respective part shape models ("features") are joined to produce a combined shape model ("macro features" resulting from processing a "macro feature template")].

Sebastian teaches to create a corresponding surface group ("macro feature") in accordance with user input ("macro feature templates") of a correspondence between the part shape models ("features") corresponding to the respective selected unit work history data ("feature templates") [(Sebastian, column 12, lines 3-25); (Sebastian, column 23, lines 9-22)].

Sebastian teaches to determine, using the corresponding surface group, errors in the combined shape model arising from the second reference surface [See column 22, et seq., in particular: "The designer starts by instantiating the nominal wall feature and uses the add-on operation to provide "Fasten" functionality. In this example, the system searches for a function template using "Fasten" as the search criteria and provides the user with the boss feature. The user specifies the parameters for the boss such as dimension and positioning information. Based on the selection, the reasoning attributes of the feature template are evaluated and the system examines the appropriate constraints. The constraints retrieve necessary additionally information from other feature templates, look-up tables and the material database 90. The constraints that pertain to the feature "boss" are evaluated, and it is found that the thickness of the boss is adequate to support the applied load. However, while considering the mold fill criteria, the thickness exceeds the manufacturer's recommendation (as retrieved from the manufacturer's external database) for the selected material. Depending on the constraint evaluation results, the user is notified through one of the following mechanisms: warning *messages, error messages and design change recommendations... In the boss example, the* system notifies the user that the "BOSS IS TOO THICK" and recommends a range of appropriate thickness values for the selected material that satisfies both the mold fill and the strength criteria." (column 22, line 18, et seq.)].

Sebastian does not expressly teach a database accumulating technical conditions as claimed, or that the errors determined using the corresponding surface group include the types recited by the claim.

Shebini teaches the database accumulating technical conditions, which are to be met by a part shape model to be created according to each unit work history data, in association with each unit work history data ["Turning to very particular structures, namely off-shore platforms, we see that they must be structurally adequate for operational and environmental loading, practical to construct, and be cost effective. The selection of a configuration is based on functional requirements and methods of installation." (Shebini, column 3, lines 60-65); "Once environmental loads are determined, they are combined with operational loads, and an estimate is made of the resulting pile mudline moments and axial forces." (Shebini, column 4, lines 33-39); "Before the design solution of either the 3-dimensional "finite Element" analysis of the superstructure and jacket, or the beam-column analysis of the piling can be considered finished, it is necessary to determine compatible conditions at the pilehead-structure interface. These equilibrium conditions are usually obtained using an interaction analysis procedure which yields the combined response of the linear structure and its non-linear soil-pile foundation for nay imposed static load condition." (Shebini, column 4, lines 55-65); et cetera. Shebini provides numerous examples of the "technical conditions" that are accumulated in columns 3 and 4];

computing at least one technical characteristic value of the combined shape model which is created from the output work data ["The equilibrium conditions determined from the interaction analysis are now imposed on the structural Model in combination with appropriate design loads, and a static analysis is performed. The internal member forces determined in this analysis are employed to check the stress levels in the members." (Shebini, column 4, line 65 - column 5, line 2)]; and

compare the computed technical characteristic value with technical conditions related to unit work history data which is the origin of the work data ["The stresses are compared to allowable stresses, as set forth in the design basis, and members resized accordingly." (Shebini, column 5, lines 2-5)];

wherein the computation of the at least one technical characteristic value comprises analyzing the strength of the combined shape model ["stress levels in the members" (Shebini, column 4, line 65 - column 5, line 5)].

Sebastian and Shebini are analogous art because both are drawn to structural modeling.

It would have been obvious to a person of ordinary skill in the art at the time of Applicants' invention to combine the teachings of Sebastian and Shebini as expressly motivated by Shebini in order to predict the structural properties of the assembled product ["Nowadays, by using the Finite Element Method (FEM), stress analysts do not have to modify the problem to conform to available solutions. No matter how complex the shape or system of loads may be, the (FEM) treats a loaded structure as being built of numerous tiny connected substructures or elements as are shown in FIG. 8. Since these elements can be put together in virtually any fashion, they can be arranged in simulate exceedingly complex shapes. Thus, the (FEM) can be used to determine stresses for structural parts where no mathematically closed form solution exists." (Shebini, column 1, lines 25-35)]. The combination could be achieved by using Shebini's structural analysis method to analyze the model described by Sebastian.

Sebastian in view of Shebini that the errors determined using the corresponding surface group include the types recited by the claim.

Barequet teaches determining errors using a corresponding surface group, the errors including at least one of a change of a number of configuring surfaces, a change in direction or quantity of border lines, reversal of a direction of a surface, and a folding of a surface ["We describe an algorithm for repairing polyhedral CAD models that have errors in their B-REP. Errors like cracks, degeneracies, duplication, holes and overlaps are usually introduced in solid models due to imprecise arithmetic, model transformations, designer's fault, programming bugs, etc." (Barequet, abstract); "If the original orientation of facets is not consistent, we need to make the following modifications to our algorithm: Orient all the facets of each connected component *consistently with respect to other facets in the component..."* (Barequet, page 366, "4.2 Orientation Checking"); "The algorithm is also able to detect non-orientable surfaces while processing a "back-edge" in the depth-first order traversal. Back-edges are used to perform a consistency check between two facets whose respective orientations are already fixed. If the two orientation do not match, the component is non-orientable and the system reports the error as such." (Barequet, page 365, "2 Computing the Connected Components")].

Sebastian in view of Shebini and Barequet are analogous art because both are directed to CAD modeling.

It would have been obvious to a person of ordinary skill in the art at the time of Applicants' invention to combine the teachings of Sebastian in view of Shebini with Barequet as expressly motivated by Barequet to identify and correct problems in the CAD model ["File forma*ts like IGES ... DXF ... and STL ... (which is a de facto standard in the rapid*-prototyping industry) allow users to represent models as such soups of polygons... The collection of polygons is assumed to represent a complete model. Unfortunately this is often not the case. Typical

problems include cracks (in the surface), degeneracies, duplication (of patches of the surface), *holes and overlaps, as shown in Figure 1... We present algorithms to eliminate dangling* geometry, T-joins, holes and cracks in a polygonal solid model, and generate consistent polygon-orientations." (Barequet, page 363, "1 Introduction")]. The combination could be achieved by using Barequet's algorithms in the system and method described by Sebastian in view of Shebini to identify and correct the same types of errors in Sebastian's CAD models. The combination would produce a system as described by Sebastian in view of Shebini but enhanced with the error identification and correction techniques taught by Barequet.

Therefore it would have been obvious to a person of ordinary skill in the art at the time of Applicants' invention to combine the teachings of Sebastian, Shebini, and Barequet to arrive at the invention specified in claim 2.

Regarding claim 5, Sebastian teaches:

The design support system according to claim 2, wherein the control section is further configured to receive designation of data about a third standard shape (FIG. 2, reference 35); wherein:

The work data is converted by reproducing a design work with reference to the designated third standard shape for work included in the work contained in the output work data and performed with reference to the second standard shape, and converted work data corresponding to a shape model conforming to the third standard shape is output [(column 11, lines 32-49); (column 12, lines 3-11)].

Regarding claim 6, Sebastian teaches:

The design support system according to claim 1, wherein the control section is further configured to analyze the history of design work and extract input work carried out by a person in charge of work when unit historical data is created [*"CreateT... creates a new template..."* (column 21, lines 50-55, etc.)]; and the design support system further including:

A display section which shows the extracted input work to the person in charge of work to request input of design support information [*"In this example, the system searches for a function template using "Fasten" as the search criteria and provides the user with the boss feature."* (column 22, lines 21-28); *"At any time the* user has the ability to modify the feature *attribute values and the system processes the effect of these changes..."* (column 22, lines 57-65)]; and

A database which records the design support information in a history of the design work and divides the history of the design work into unit historical data when the design support information is input so to show when the design support information is reused (column 22, lines 41-65).

Regarding claim 7, Sebastian teaches:

A design support system which holds a series of design work histories to reuse as work history data and creates a shape based on the work history data [(abstract); (column 11, lines 32-49); (column 12, lines 3-11)], comprising:

A control section which analyzes the work history data, comprising a first reference surface, by sequentially reproducing unit work history data one by one to extract input work,

comprising a second reference surface, carried out by a person in charge of work [(column 11, lines 32-49), (column 21, lines 50-55, etc.); Sebastian expressly provides an example of the feature templates being used sequentially, one by one, to construct an assembly (Sebastian, column 20, line 63 - column 23, line 8)];

Sebastian teaches to create a corresponding surface group ("macro feature") in accordance with user input ("macro feature templates") between the first reference surface and the second reference surface [(Sebastian, column 12, lines 3-25); (Sebastian, column 23, lines 9-22)].

Sebastian teaches to determine, using the corresponding surface group, errors in the combined shape model arising from the second reference surface [See column 22, et seq., in particular: "The designer starts by instantiating the nominal wall feature and uses the add-on operation to provide "Fasten" functionality. In this example, the system searches for a function template using "Fasten" as the search criteria and provides the user with the boss feature. The user specifies the parameters for the boss such as dimension and positioning information. Based on the selection, the reasoning attributes of the feature template are evaluated and the system examines the appropriate constraints. The constraints retrieve necessary additionally information from other feature templates, look-up tables and the material database 90. The constraints that pertain to the feature "boss" are evaluated, and it is found that the thickness of the boss is adequate to support the applied load. However, while considering the mold fill criteria, the thickness exceeds the manufacturer's recommendation (as retrieved from the manufacturer's external database) for the selected material. Depending on the constraint evaluation results, the user is notified through one of the following mechanisms: warning

messages, error messages and design chan*ge recommendations... In the boss example, the* system notifies the user that the "BOSS IS TOO THICK" and recommends a range of appropriate thickness values for the selected material that satisfies both the mold fill and the strength criteria." (column 22, line 18, et seq.)].

A display section which shows the extracted input work to the person in charge of work to request input of design support information (column 22, lines 21-65); and

A database which records the design support information in the work history data when the design support information is input so to show when the design support information is reused (column 22, lines 41-65).

Sebastian does not expressly teach a database accumulating technical conditions as claimed, or that the errors detected using the corresponding surface group include the types recited by the claim.

Shebini teaches the database accumulating technical conditions, which are to be met by the shape created based on the work history data, in association with the work history data ["Turning to very particular structures, namely off-shore platforms, we see that they must be structurally adequate for operational and environmental loading, practical to construct, and be cost effective. The selection of a configuration is based on functional requirements and methods of installation." (Shebini, column 3, lines 60-65); "Once environmental loads are determined, they are combined with operational loads, and an estimate is made of the resulting pile mudline moments and axial forces." (Shebini, column 4, lines 33-39); "Before the design solution of either the 3-dimensional "finite Element" analysis of the superstructure and jacket, or the beam-column analysis of the piling can be considered finished, it is necessary to determine compatible

conditions at the pilehead-structure interface. These equilibrium conditions are usually obtained using an interaction analysis procedure which yields the combined response of the linear structure and its non-linear soil-pile foundation for nay imposed static load condition." (Shebini, column 4, lines 55-65); et cetera. Shebini provides numerous examples of the "technical conditions" that are accumulated in columns 3 and 4];

computing at least one technical characteristic value of the shape which is created based on the work history data ["The equilibrium conditions determined from the interaction analysis are now imposed on the structural Model in combination with appropriate design loads, and a static analysis is performed. The internal member forces determined in this analysis are employed to check the stress levels in the members." (Shebini, column 4, line 65 - column 5, line 2)]; and

comparing the computed technical characteristic value with technical conditions related to work history data which is the origin of the work data ["The stresses are compared to allowable stresses, as set forth in the design basis, and members resized accordingly." (Shebini, column 5, lines 2-5)];

wherein the computation of the at least one technical characteristic value comprises analyzing the strength of the shape ["stress levels in the members" (Shebini, column 4, line 65 - column 5, line 5)].

Sebastian and Shebini are analogous art because both are drawn to structural modeling.

It would have been obvious to a person of ordinary skill in the art at the time of Applicants' invention to combine the teachings of Sebastian and Shebini as expressly motivated by Shebini in order to predict the structural properties of the assembled product ["Nowadays, by

using the Finite Element Method (FEM), stress analysts do not have to modify the problem to conform to available solutions. No matter how complex the shape or system of loads may be, the (FEM) treats a loaded structure as being built of numerous tiny connected substructures or elements as are shown in FIG. 8. Since these elements can be put together in virtually any fashion, they can be arranged in simulate exceedingly complex shapes. Thus, the (FEM) can be used to determine stresses for structural parts where no mathematically closed form solution exists." (Shebini, column 1, lines 25-35)]. The combination could be achieved by using Shebini's structural analysis method to analyze the model described by Sebastian.

Sebastian in view of Shebini does not expressly that the errors determined using the corresponding surface group include the types recited by the claim.

Barequet teaches determining errors using a corresponding surface group, the errors including at least one of a change of a number of configuring surfaces, a change in direction or quantity of border lines, reversal of a direction of a surface, and a folding of a surface ["We describe an algorithm for repairing polyhedral CAD models that have errors in their B-REP. Errors like cracks, degeneracies, duplication, holes and overlaps are usually introduced in solid models due to imprecise arithmetic, model transformations, designer's fault, programming bugs, etc." (Barequet, abstract); "If the original orientation of facets is not consistent, we need to make the following modifications to our algorithm: Orient all the facets of each connected component *consistently with respect to other facets in the component..."* (Barequet, page 366, "4.2 Orientation Checking"); "The algorithm is also able to detect non-orientable surfaces while processing a "back-edge" in the depth-first order traversal. Back-edges are used to perform a consistency check between two facets whose respective orientations are already fixed. If the two

orientation do not match, the component is non-orientable and the system reports the error as such." (Barequet, page 365, "2 Computing the Connected Components")].

Sebastian in view of Shebini and Barequet are analogous art because both are directed to CAD modeling.

It would have been obvious to a person of ordinary skill in the art at the time of Applicants' invention to combine the teachings of Sebastian in view of Shebini with Barequet as expressly motivated by Barequet to identify and correct problems in the CAD model ["File *formats like IGES ... DXF ... and STL ... (w*hich is a de facto standard in the rapid-prototyping industry) allow users to represent models as such soups of polygons... The collection of polygons is assumed to represent a complete model. Unfortunately this is often not the case. Typical problems include cracks (in the surface), degeneracies, duplication (of patches of the surface), *holes and overlaps, as shown in Figure 1... We present algorithms to eliminate dangling* geometry, T-joins, holes and cracks in a polygonal solid model, and generate consistent polygon-orientations." (Barequet, page 363, "1 Introduction")]. The combination could be achieved by using Barequet's algorithms in the system and method described by Sebastian in view of Shebini to identify and correct the same types of errors in Sebastian's CAD models. The combination would produce a system as described by Sebastian in view of Shebini but enhanced with the error identification and correction techniques taught by Barequet.

Therefore it would have been obvious to a person of ordinary skill in the art at the time of Applicants' invention to combine the teachings of Sebastian, Shebini, and Barequet to arrive at the invention specified in claim 7.

Regarding claim 8, Sebastian teaches:

The design support system according to claim 7, wherein the database is further configured to generate unit work history data by dividing the work history data into predetermined work units for a design target (column 21, lines 50-55, etc.).

Regarding claim 9, Sebastian teaches:

A design support system (abstract), comprising:

A database which accumulates unit work history data which is formed by dividing a history of past design work, comprising a first reference surface, into work units determined for a design target and contains design support information related to input work among the design work [(column 11, lines 32-49); (column 12, lines 3-11)];

A control section configured to selectively show the unit work history on a display section upon receiving designation of the design target [(column 22, lines 21-65) alternatively (column 16, lines 19-47)];

Create a shape comprising a second reference surface by sequentially reproducing the selected unit work history one by one [(column 11, lines 32-49); (column 12, lines 3-11); Sebastian provides an example of the feature templates being used sequentially, one by one, to construct an assembly (Sebastian, column 20, line 63 - column 23, line 8)];

Provide design support information related to input work when the input work is demanded while the unit work history is being reproduced [(column 22, lines 21-65) alternatively (column 16, lines 19-47)];

combine at least two selected work history data and output design work data for creating a combined shape model [See, e.g., (Sebastian, column 12, lines 3-25) describing "feature templates" which correspond to the claimed "work history data"; and (Sebastian, column 23, lines 9-22) describing "macro-features" and "macro-feature templates" which correspond to the claimed "combined shape model"]

the combined shape model comprising a second reference surface [See, e.g., (Sebastian, column 23, lines 9-22) describing the assembly of feature templates into a "macro-feature", and the macro-feature itself being a "feature" in the CAD system. Sebastian teaches that features comprise a reference surface (See, e.g., Sebastian, column 11, lines 32-49) and consequently the creation of a "macro-feature" from a combination of sub-features comprises the creation of a "second reference surface"];

the second reference surface is formed by sequentially reproducing the selected unit work history data one by one and joining part shape models corresponding to the respective selected unit work history data [See, e.g., (Sebastian, FIGS. 2A-2B) depicting a diagrammatic representation of an example feature template, and (Sebastian, column 12, lines 39 et seq.) describing how the example feature template is constructed. Further, (Sebastian, column 23, lines 9-22) describes how feature templates may be combined to form macro feature templates. Sebastian provides an example of the feature templates being used sequentially, one by one, to construct an assembly (Sebastian, column 20, line 63 - column 23, line 8). That is, the selected individual work history data ("feature templates") are sequentially reproduced, one by one (i.e. processing a "macro feature templates"), and their respective part shape models ("features") are

joined to produce a combined shape model ("macro features" resulting from processing a "macro feature template")].

Sebastian teaches to create a corresponding surface group ("macro feature") in accordance with user input ("macro feature templates") of a correspondence between the part shape models ("features") corresponding to the respective selected unit work history data ("feature templates") [(Sebastian, column 12, lines 3-25); (Sebastian, column 23, lines 9-22)].

Sebastian teaches to determine, using the corresponding surface group, errors in the combined shape model arising from the second reference surface [See column 22, et seq., in particular: "The designer starts by instantiating the nominal wall feature and uses the add-on operation to provide "Fasten" functionality. In this example, the system searches for a function template using "Fasten" as the search criteria and provides the user with the boss feature. The user specifies the parameters for the boss such as dimension and positioning information. Based on the selection, the reasoning attributes of the feature template are evaluated and the system examines the appropriate constraints. The constraints retrieve necessary additionally information from other feature templates, look-up tables and the material database 90. The constraints that pertain to the feature "boss" are evaluated, and it is found that the thickness of the boss is adequate to support the applied load. However, while considering the mold fill criteria, the thickness exceeds the manufacturer's recommendation (as retrieved from the manufacturer's external database) for the selected material. Depending on the constraint evaluation results, the user is notified through one of the following mechanisms: warning *messages, error messages and design change recommendations... In the boss example, the* system notifies the user that the "BOSS IS TOO THICK" and recommends a range of appropriate

thickness values for the selected material that satisfies both the mold fill and the strength criteria." (column 22, line 18, et seq.)].

Sebastian does not expressly teach a database accumulating technical conditions as claimed, or that the errors determined using the corresponding surface group include the types recited by the claim.

Shebini teaches the database accumulating technical conditions, which are to be met by the part shape model to be created based on each work history data, in association with each work history data ["Turning to very particular structures, namely off-shore platforms, we see that they must be structurally adequate for operational and environmental loading, practical to construct, and be cost effective. The selection of a configuration is based on functional requirements and methods of installation." (Shebini, column 3, lines 60-65); "Once environmental loads are determined, they are combined with operational loads, and an estimate is made of the resulting pile mudline moments and axial forces." (Shebini, column 4, lines 33-39); "Before the design solution of either the 3-dimensional "finite Element" analysis of the superstructure and jacket, or the beam-column analysis of the piling can be considered finished, it is necessary to determine compatible conditions at the pilehead-structure interface. These equilibrium conditions are usually obtained using an interaction analysis procedure which yields the combined response of the linear structure and its non-linear soil-pile foundation for nay imposed static load condition." (Shebini, column 4, lines 55-65); et cetera. Shebini provides numerous examples of the "technical conditions" that are accumulated in columns 3 and 4];

computing at least one technical characteristic value of the shape which is created based on the work history data ["The equilibrium conditions determined from the interaction analysis

are now imposed on the structural Model in combination with appropriate design loads, and a static analysis is performed. The internal member forces determined in this analysis are employed to check the stress levels in the members." (Shebini, column 4, line 65 - column 5, line 2)]; and

comparing the computed technical characteristic value with technical conditions related to work history data which is the origin of the work data ["The stresses are compared to allowable stresses, as set forth in the design basis, and members resized accordingly." (Shebini, column 5, lines 2-5)];

wherein the computation of the at least one technical characteristic value comprises analyzing the strength of the shape ["stress levels in the members" (Shebini, column 4, line 65 - column 5, line 5)].

Sebastian and Shebini are analogous art because both are drawn to structural modeling.

It would have been obvious to a person of ordinary skill in the art at the time of Applicants' invention to combine the teachings of Sebastian and Shebini as expressly motivated by Shebini in order to predict the structural properties of the assembled product ["Nowadays, by using the Finite Element Method (FEM), stress analysts do not have to modify the problem to conform to available solutions. No matter how complex the shape or system of loads may be, the (FEM) treats a loaded structure as being built of numerous tiny connected substructures or elements as are shown in FIG. 8. Since these elements can be put together in virtually any fashion, they can be arranged in simulate exceedingly complex shapes. Thus, the (FEM) can be used to determine stresses for structural parts where no mathematically closed form solution

exists." (Shebini, column 1, lines 25-35)]. The combination could be achieved by using Shebini's structural analysis method to analyze the model described by Sebastian.

Sebastian in view of Shebini does not expressly teach that the errors determined using the corresponding surface group include the types recited by the claim.

Barequet teaches determining errors using a corresponding surface group, the errors including at least one of a change of a number of configuring surfaces, a change in direction or quantity of border lines, reversal of a direction of a surface, and a folding of a surface ["We describe an algorithm for repairing polyhedral CAD models that have errors in their B-REP. Errors like cracks, degeneracies, duplication, holes and overlaps are usually introduced in solid models due to imprecise arithmetic, model transformations, designer's fault, programming bugs, etc." (Barequet, abstract); "If the original orientation of facets is not consistent, we need to make the following modifications to our algorithm: Orient all the facets of each connected component *consistently with respect to other facets in the component..."* (Barequet, page 366, "4.2 Orientation Checking"); "The algorithm is also able to detect non-orientable surfaces while processing a "back-edge" in the depth-first order traversal. Back-edges are used to perform a consistency check between two facets whose respective orientations are already fixed. If the two orientation do not match, the component is non-orientable and the system reports the error as such." (Barequet, page 365, "2 Computing the Connected Components")].

Sebastian in view of Shebini and Barequet are analogous art because both are directed to CAD modeling.

It would have been obvious to a person of ordinary skill in the art at the time of Applicants' invention to combine the teachings of Sebastian in view of Shebini with Barequet as

expressly motivated by Barequet to identify and correct problems in the CAD model ["File *formats like IGES ... DXF ... and STL ... (which is a de facto standard in the rapid*-prototyping industry) allow users to represent models as such soups of polygons... The collection of polygons is assumed to represent a complete model. Unfortunately this is often not the case. Typical problems include cracks (in the surface), degeneracies, duplication (of patches of the surface), *holes and overlaps, as shown in Figure 1... We present algorithms to eliminate dangling* geometry, T-joins, holes and cracks in a polygonal solid model, and generate consistent polygon-orientations." (Barequet, page 363, "1 Introduction")]. The combination could be achieved by using Barequet's algorithms in the system and method described by Sebastian in view of Shebini to identify and correct the same types of errors in Sebastian's CAD models. The combination would produce a system as described by Sebastian in view of Shebini but enhanced with the error identification and correction techniques taught by Barequet.

Therefore it would have been obvious to a person of ordinary skill in the art at the time of Applicants' invention to combine the teachings of Sebastian, Shebini, and Barequet to arrive at the invention specified in claim 9.

Regarding claim 10, Sebastian teaches:

The design support system according to claim 9, wherein the control section is further configured to judge whether the work history to be reproduced agrees with predetermined guidance display conditions while the unit work history is being reproduced (column 22, lines 21-65); and wherein

The display section is further configured to implement a guidance display determined in connection with the guide display conditions if the work history agrees with the guidance display conditions (column 22, lines 21-65).

Regarding claim 11, Sebastian teaches:

A database which accumulates unit work history data which is formed by dividing a history of past design work into work units, comprising a first reference surface, determined for a design target and contains design support information related to an input work among the design work [(abstract); (column 11, lines 32-49); (column 12, lines 3-11)];

A first display device which shows a shape, comprising a second reference surface, of the design target obtained by sequentially reproducing a history of the design work one by one with reference to the unit work history data [*"The representative embodiment supports, amongst* others, the following interfaces: to CAD systems – IGES, Pro-Engineer and IDEAS; for FEM structural analysis – PATRAN/NASTRAN and IDEAS; for FEM molding filling, cooling and shrinkage analysis – C-FLOW, IDEAS, Moldflow and TMC; and for tool design – IDEAS, Pro-*Engineer and DME Moldbase Catalog."* (column 18, lines 35-41); Sebastian provides an example of the feature templates being used sequentially, one by one, to construct an assembly (Sebastian, column 20, line 63 - column 23, line 8). That is, the selected individual work history data ("feature templates") are sequentially reproduced, one by one (i.e. processing a "macro feature templates"), and their respective part shape models ("features") are joined to produce a combined shape model ("macro features" resulting from processing a "macro feature template")];

A second display device which shows design support information contained in the unit work history data by reproducing a history of the design work prior to the reproduction at the first display device [(column 18, lines 35-41); (column 11, lines 21-26)]; and

a control section which:

creates a corresponding surface group ("macro feature") in accordance with user input ("macro feature templates") of a correspondence between the part shape models ("features") corresponding to each unit work history data ("feature templates") [(Sebastian, column 12, lines 3-25); (Sebastian, column 23, lines 9-22)].

Sebastian teaches to determine, using the corresponding surface group, errors in the combined shape model arising from the second reference surface [See column 22, et seq., in particular: "The designer starts by instantiating the nominal wall feature and uses the add-on operation to provide "Fasten" functionality. In this example, the system searches for a function template using "Fasten" as the search criteria and provides the user with the boss feature. The user specifies the parameters for the boss such as dimension and positioning information. Based on the selection, the reasoning attributes of the feature template are evaluated and the system examines the appropriate constraints. The constraints retrieve necessary additionally information from other feature templates, look-up tables and the material database 90. The constraints that pertain to the feature "boss" are evaluated, and it is found that the thickness of the boss is adequate to support the applied load. However, while considering the mold fill criteria, the thickness exceeds the manufacturer's recommendation (as retrieved from the manufacturer's external database) for the selected material. Depending on the constraint evaluation results, the user is notified through one of the following mechanisms: warning messages, error messages and

design change recommendations… In the boss example, the system notifies the user that the "BOSS IS TOO THICK" and recommends a range of appropriate thickness values for the selected material that satisfies both the mold fill and the strength criteria." (column 22, line 18, et seq.)]. combine at least two selected work history data and output design work data for creating a combined shape model [See, e.g., (Sebastian, column 12, lines 3-25) describing "feature templates" which correspond to the claimed "work history data"; and (Sebastian, column 23, lines 9-22) describing "macro-features" and "macro-feature templates" which correspond to the claimed "combined shape model"]

Sebastian does not expressly teach a database accumulating technical conditions as claimed, or that the errors determined using the corresponding surface group include the types recited by the claim.

Shebini teaches the database accumulating technical conditions, which are to be met by the part shape model to be created based on each work history data, in association with each work history data ["Turning to very particular structures, namely off-shore platforms, we see that they must be structurally adequate for operational and environmental loading, practical to construct, and be cost effective. The selection of a configuration is based on functional requirements and methods of installation." (Shebini, column 3, lines 60-65); "Once environmental loads are determined, they are combined with operational loads, and an estimate is made of the resulting pile mudline moments and axial forces." (Shebini, column 4, lines 33-39); "Before the design solution of either the 3-dimensional "finite Element" analysis of the superstructure and jacket, or the beam-column analysis of the piling can be considered finished, it is necessary to determine compatible conditions at the pilehead-structure interface. These

equilibrium conditions are usually obtained using an interaction analysis procedure which yields the combined response of the linear structure and its non-linear soil-pile foundation for nay imposed static load condition." (Shebini, column 4, lines 55-65); et cetera. Shebini provides numerous examples of the "technical conditions" that are accumulated in columns 3 and 4];

computing at least one technical characteristic value of the shape which is created based on the work history data ["The equilibrium conditions determined from the interaction analysis are now imposed on the structural Model in combination with appropriate design loads, and a static analysis is performed. The internal member forces determined in this analysis are employed to check the stress levels in the members." (Shebini, column 4, line 65 - column 5, line 2)]; and

comparing the computed technical characteristic value with technical conditions related to work history data which is the origin of the work data ["The stresses are compared to allowable stresses, as set forth in the design basis, and members resized accordingly." (Shebini, column 5, lines 2-5)];

wherein the computation of the at least one technical characteristic value comprises analyzing the strength of the shape ["stress levels in the members" (Shebini, column 4, line 65 - column 5, line 5)].

Sebastian and Shebini are analogous art because both are drawn to structural modeling.

It would have been obvious to a person of ordinary skill in the art at the time of Applicants' invention to combine the teachings of Sebastian and Shebini as expressly motivated by Shebini in order to predict the structural properties of the assembled product ["Nowadays, by using the Finite Element Method (FEM), stress analysts do not have to modify the problem to

conform to available solutions. No matter how complex the shape or system of loads may be, the (FEM) treats a loaded structure as being built of numerous tiny connected substructures or elements as are shown in FIG. 8. Since these elements can be put together in virtually any fashion, they can be arranged in simulate exceedingly complex shapes. Thus, the (FEM) can be used to determine stresses for structural parts where no mathematically closed form solution exists." (Shebini, column 1, lines 25-35)]. The combination could be achieved by using Shebini's structural analysis method to analyze the model described by Sebastian.

Sebastian in view of Shebini does not expressly teach that the errors determined using the corresponding surface group include the types recited by the claim.

Barequet teaches determining errors using a corresponding surface group, the errors including at least one of a change of a number of configuring surfaces, a change in direction or quantity of border lines, reversal of a direction of a surface, and a folding of a surface ["We describe an algorithm for repairing polyhedral CAD models that have errors in their B-REP. Errors like cracks, degeneracies, duplication, holes and overlaps are usually introduced in solid models due to imprecise arithmetic, model transformations, designer's fault, programming bugs, etc." (Barequet, abstract); "If the original orientation of facets is not consistent, we need to make the following modifications to our algorithm: Orient all the facets of each connected component consistently with respe*ct to other facets in the component..."* (Barequet, page 366, "4.2 Orientation Checking"); "The algorithm is also able to detect non-orientable surfaces while processing a "back-edge" in the depth-first order traversal. Back-edges are used to perform a consistency check between two facets whose respective orientations are already fixed. If the two

orientation do not match, the component is non-orientable and the system reports the error as such." (Barequet, page 365, "2 Computing the Connected Components")].

Sebastian in view of Shebini and Barequet are analogous art because both are directed to CAD modeling.

It would have been obvious to a person of ordinary skill in the art at the time of Applicants' invention to combine the teachings of Sebastian in view of Shebini with Barequet as expressly motivated by Barequet to identify and correct problems in the CAD model ["File *formats like IGES ... DXF ... and STL ... (which is a de facto standard in the rapid*-prototyping industry) allow users to represent models as such soups of polygons... The collection of polygons is assumed to represent a complete model. Unfortunately this is often not the case. Typical problems include cracks (in the surface), degeneracies, duplication (of patches of the surface), holes and overla*ps, as shown in Figure 1... We present algorithms to eliminate dangling* geometry, T-joins, holes and cracks in a polygonal solid model, and generate consistent polygon-orientations." (Barequet, page 363, "1 Introduction")]. The combination could be achieved by using Barequet's algorithms in the system and method described by Sebastian in view of Shebini to identify and correct the same types of errors in Sebastian's CAD models. The combination would produce a system as described by Sebastian in view of Shebini but enhanced with the error identification and correction techniques taught by Barequet.

Therefore it would have been obvious to a person of ordinary skill in the art at the time of Applicants' invention to combine the teachings of Sebastian, Shebini, and Barequet to arrive at the invention specified in claim 11.

Regarding claim 12, Sebastian teaches:

A design support method using a computer, wherein:

A series of design work histories is held in multiple quantities as work history data, comprising a first reference surface in a database in order to create a part shape model [(abstract); (column 11, lines 32-49); (column 12, lines 3-11); (column 13, lines 44-46)];

At least two selected history data are fetched from the held multiple work history data according to an instruction input to a processor (column 22, lines 21-65); and

Design work data for creating a one-piece shape model comprising a second reference surface by sequentially reproducing unit work history data one by one and combining the at least two fetched work history data and connecting part shape models corresponding to the respective work history data is output [(column 11, line 32 - column 12, line 11); See, e.g., (Sebastian, FIGS. 2A-2B) depicting a diagrammatic representation of an example feature template, and (Sebastian, column 12, lines 39 et seq.) describing how the example feature template is constructed. Further, (Sebastian, column 23, lines 9-22) describes how feature templates may be combined to form macro feature templates. Sebastian provides an example of the feature templates being used sequentially, one by one, to construct an assembly (Sebastian, column 20, line 63 - column 23, line 8). That is, the selected individual work history data ("feature templates") are sequentially reproduced, one by one (i.e. processing a "macro feature templates"), and their respective part shape models ("features") are joined to produce a combined shape model ("macro features" resulting from processing a "macro feature template")];

a corresponding surface group ("macro feature") is created by a control section in accordance with user input ("macro feature templates") of a correspondence between the part

shape models ("features") corresponding to the respective selected unit work history data ("feature templates") [(Sebastian, column 12, lines 3-25); (Sebastian, column 23, lines 9-22)];

errors in the one-piece shape model arising from the second reference surface are determined, using the corresponding surface group, by the control section [See column 22, et seq., in particular: "The designer starts by instantiating the nominal wall feature and uses the add-on operation to provide "Fasten" functionality. In this example, the system searches for a function template using "Fasten" as the search criteria and provides the user with the boss feature. The user specifies the parameters for the boss such as dimension and positioning information. Based on the selection, the reasoning attributes of the feature template are evaluated and the system examines the appropriate constraints. The constraints retrieve necessary additionally information from other feature templates, look-up tables and the material database 90. The constraints that pertain to the feature "boss" are evaluated, and it is found that the thickness of the boss is adequate to support the applied load. However, while considering the mold fill criteria, the thickness exceeds the manufacturer's recommendation (as retrieved from the manufacturer's external database) for the selected material. Depending on the constraint evaluation results, the user is notified through one of the following mechanisms: *warning messages, error messages and design change recommendations... In the boss example,* the system notifies the user that the "BOSS IS TOO THICK" and recommends a range of appropriate thickness values for the selected material that satisfies both the mold fill and the strength criteria." (column 22, line 18, et seq.)].

Sebastian does not expressly teach a database accumulating technical conditions as claimed, or that the errors determined using the corresponding surface group include the types recited by the claim.

Shebini teaches the database accumulating technical conditions, which are to be met by the part shape model to be created according to each work history data, in association with each work history data ["Turning to very particular structures, namely off-shore platforms, we see that they must be structurally adequate for operational and environmental loading, practical to construct, and be cost effective. The selection of a configuration is based on functional requirements and methods of installation." (Shebini, column 3, lines 60-65); "Once environmental loads are determined, they are combined with operational loads, and an estimate is made of the resulting pile mudline moments and axial forces." (Shebini, column 4, lines 33-39); "Before the design solution of either the 3-dimensional "finite Element" analysis of the superstructure and jacket, or the beam-column analysis of the piling can be considered finished, it is necessary to determine compatible conditions at the pilehead-structure interface. These equilibrium conditions are usually obtained using an interaction analysis procedure which yields the combined response of the linear structure and its non-linear soil-pile foundation for nay imposed static load condition." (Shebini, column 4, lines 55-65); et cetera. Shebini provides numerous examples of the "technical conditions" that are accumulated in columns 3 and 4];

computing at least one technical characteristic value of the one-piece shape model which is created based on the work history data ["The equilibrium conditions determined from the interaction analysis are now imposed on the structural Model in combination with appropriate design loads, and a static analysis is performed. The internal member forces determined in this

analysis are employed to check the stress levels in the members." (Shebini, column 4, line 65 - column 5, line 2)]; and

comparing the computed technical characteristic value with technical conditions related to work history data which is the origin of the design work data ["The stresses are compared to allowable stresses, as set forth in the design basis, and members resized accordingly." (Shebini, column 5, lines 2-5)];

wherein the computation of the at least one technical characteristic value comprises analyzing the strength of the one-piece shape model ["stress levels in the members" (Shebini, column 4, line 65 - column 5, line 5)].

Sebastian and Shebini are analogous art because both are drawn to structural modeling.

It would have been obvious to a person of ordinary skill in the art at the time of Applicants' invention to combine the teachings of Sebastian and Shebini as expressly motivated by Shebini in order to predict the structural properties of the assembled product ["Nowadays, by using the Finite Element Method (FEM), stress analysts do not have to modify the problem to conform to available solutions. No matter how complex the shape or system of loads may be, the (FEM) treats a loaded structure as being built of numerous tiny connected substructures or elements as are shown in FIG. 8. Since these elements can be put together in virtually any fashion, they can be arranged in simulate exceedingly complex shapes. Thus, the (FEM) can be used to determine stresses for structural parts where no mathematically closed form solution exists." (Shebini, column 1, lines 25-35)]. The combination could be achieved by using Shebini's structural analysis method to analyze the model described by Sebastian.

Sebastian in view of Shebini does not expressly teach that the errors determined using the corresponding surface group include the types recited by the claim.

Barequet teaches determining errors using a corresponding surface group, the errors including at least one of a change of a number of configuring surfaces, a change in direction or quantity of border lines, reversal of a direction of a surface, and a folding of a surface ["We describe an algorithm for repairing polyhedral CAD models that have errors in their B-REP. Errors like cracks, degeneracies, duplication, holes and overlaps are usually introduced in solid models due to imprecise arithmetic, model transformations, designer's fault, programming bugs, etc." (Barequet, abstract); "If the original orientation of facets is not consistent, we need to make the following modifications to our algorithm: Orient all the facets of each connected component *consistently with respect to other facets in the component..."* (Barequet, page 366, "4.2 Orientation Checking"); "The algorithm is also able to detect non-orientable surfaces while processing a "back-edge" in the depth-first order traversal. Back-edges are used to perform a consistency check between two facets whose respective orientations are already fixed. If the two orientation do not match, the component is non-orientable and the system reports the error as such." (Barequet, page 365, "2 Computing the Connected Components")].

Sebastian in view of Shebini and Barequet are analogous art because both are directed to CAD modeling.

It would have been obvious to a person of ordinary skill in the art at the time of Applicants' invention to combine the teachings of Sebastian in view of Shebini with Barequet as expressly motivated by Barequet to identify and correct problems in the CAD model ["File *formats like IGES ... DXF ... and STL ... (which is a de facto standard in the rapid*-prototyping

industry) allow users to represent models as such soups of polygons... The collection of polygons is assumed to represent a complete model. Unfortunately this is often not the case. Typical problems include cracks (in the surface), degeneracies, duplication (of patches of the surface), *holes and overlaps, as shown in Figure 1... We present algori*thms to eliminate dangling geometry, T-joins, holes and cracks in a polygonal solid model, and generate consistent polygon-orientations." (Barequet, page 363, "1 Introduction")]. The combination could be achieved by using Barequet's algorithms in the system and method described by Sebastian in view of Shebini to identify and correct the same types of errors in Sebastian's CAD models. The combination would produce a system as described by Sebastian in view of Shebini but enhanced with the error identification and correction techniques taught by Barequet.

Therefore it would have been obvious to a person of ordinary skill in the art at the time of Applicants' invention to combine the teachings of Sebastian, Shebini, and Barequet to arrive at the invention specified in claim 12.

Regarding claim 13, Sebastian teaches:

A design support method which uses a computer to create a shape model of a design target conforming to a desired standard shape according to input to its processor and outputs work data for creating the shape model of the design target [(abstract); (column 11, lines 32-49); (column 12, lines 3-11); (column 13, lines 44-46)], comprising the steps of:

Holding a plurality of histories of design work performed in the past with reference to the respective standard shapes, comprising a first reference surface, in a database as work history data (column 13, lines 44-46);

Accepting designation of data about a second standard shape, which is a desired standard shape, according to an instruction input to the processor (column 22, lines 21-65);

Fetching the selected multiple work history data from the multiple work history data held in the database (column 22, lines 21-65); and

combine the respective pieces of the fetched work history data, sequentially reproduce unit work history data one by one, reproduce design work with reference to the designated second standard shape for the design works performed in the past with reference to the respective standard shapes among the design work contained in the unit work history data [See, e.g., (Sebastian, column 12, lines 3-25) describing "feature templates" which correspond to the claimed "work history data"; and (Sebastian, column 23, lines 9-22) describing "macro-features" and "macro-feature templates" which correspond to the claimed "combined shape model"; See, e.g., (Sebastian, FIGS. 2A-2B) depicting a diagrammatic representation of an example feature template, and (Sebastian, column 12, lines 39 et seq.) describing how the example feature template is constructed. Further, (Sebastian, column 23, lines 9-22) describes how feature templates may be combined to form macro feature templates. Sebastian provides an example of the feature templates being used sequentially, one by one, to construct an assembly (Sebastian, column 20, line 63 - column 23, line 8). That is, the selected individual work history data ("feature templates") are sequentially reproduced, one by one (i.e. processing a "macro feature templates"), and their respective part shape models ("features") are joined to produce a combined shape model ("macro features" resulting from processing a "macro feature template")];

and outputting work data corresponding to a combined shape model comprising a second reference surface conforming to the second standard shape [See, e.g., (Sebastian, column 23,

lines 9-22) describing the assembly of feature templates into a "macro-feature", and the macro-feature itself being a "feature" in the CAD system. Sebastian teaches that features comprise a reference surface (See, e.g., Sebastian, column 11, lines 32-49) and consequently the creation of a "macro-feature" from a combination of sub-features comprises the creation of a "second reference surface"];

Sebastian teaches to create a corresponding surface group ("macro feature") in accordance with user input ("macro feature templates") of a correspondence between the part shape models ("features") corresponding to the respective selected unit work history data ("feature templates") [(Sebastian, column 12, lines 3-25); (Sebastian, column 23, lines 9-22)].

Sebastian teaches to determine, using the corresponding surface group, errors in the combined shape model arising from the second reference surface [See column 22, et seq., in particular: "The designer starts by instantiating the nominal wall feature and uses the add-on operation to provide "Fasten" functionality. In this example, the system searches for a function template using "Fasten" as the search criteria and provides the user with the boss feature. The user specifies the parameters for the boss such as dimension and positioning information. Based on the selection, the reasoning attributes of the feature template are evaluated and the system examines the appropriate constraints. The constraints retrieve necessary additionally information from other feature templates, look-up tables and the material database 90. The constraints that pertain to the feature "boss" are evaluated, and it is found that the thickness of the boss is adequate to support the applied load. However, while considering the mold fill criteria, the thickness exceeds the manufacturer's recommendation (as retrieved from the manufacturer's external database) for the selected material. Depending on the constraint evaluation results, the

user is notified through one of the following mechanisms: warning messages, error messages and design change recommendations… In the boss example, the system notifies the user that the "BOSS IS TOO THICK" and recommends a range of appropriate thickness values for the selected material that satisfies both the mold fill and the strength criteria." (column 22, line 18, et seq.)].

Sebastian does not expressly teach a database accumulating technical conditions as claimed, or that the errors determined using the corresponding surface group include the types recited by the claim.

Shebini teaches the database accumulating technical conditions, which are to be met by the part shape model to be created according to each work history data, in association with each work history data ["Turning to very particular structures, namely off-shore platforms, we see that they must be structurally adequate for operational and environmental loading, practical to construct, and be cost effective. The selection of a configuration is based on functional requirements and methods of installation." (Shebini, column 3, lines 60-65); "Once environmental loads are determined, they are combined with operational loads, and an estimate is made of the resulting pile mudline moments and axial forces." (Shebini, column 4, lines 33-39); "Before the design solution of either the 3-dimensional "finite Element" analysis of the superstructure and jacket, or the beam-column analysis of the piling can be considered finished, it is necessary to determine compatible conditions at the pilehead-structure interface. These equilibrium conditions are usually obtained using an interaction analysis procedure which yields the combined response of the linear structure and its non-linear soil-pile foundation for nay

imposed static load condition." (Shebini, column 4, lines 55-65); et cetera. Shebini provides numerous examples of the "technical conditions" that are accumulated in columns 3 and 4];

computing at least one technical characteristic value of the one-piece shape model which is created based on the fetched work history data ["The equilibrium conditions determined from the interaction analysis are now imposed on the structural Model in combination with appropriate design loads, and a static analysis is performed. The internal member forces determined in this analysis are employed to check the stress levels in the members." (Shebini, column 4, line 65 - column 5, line 2)]; and

comparing the computed technical characteristic value with technical conditions related to work history data which is the origin of the design work data ["The stresses are compared to allowable stresses, as set forth in the design basis, and members resized accordingly." (Shebini, column 5, lines 2-5)];

wherein the computation of the at least one technical characteristic value comprises analyzing the strength of the one-piece shape model ["stress levels in the members" (Shebini, column 4, line 65 - column 5, line 5)].

Sebastian and Shebini are analogous art because both are drawn to structural modeling.

It would have been obvious to a person of ordinary skill in the art at the time of Applicants' invention to combine the teachings of Sebastian and Shebini as expressly motivated by Shebini in order to predict the structural properties of the assembled product ["Nowadays, by using the Finite Element Method (FEM), stress analysts do not have to modify the problem to conform to available solutions. No matter how complex the shape or system of loads may be, the (FEM) treats a loaded structure as being built of numerous tiny connected substructures or

elements as are shown in FIG. 8. Since these elements can be put together in virtually any fashion, they can be arranged in simulate exceedingly complex shapes. Thus, the (FEM) can be used to determine stresses for structural parts where no mathematically closed form solution exists." (Shebini, column 1, lines 25-35)]. The combination could be achieved by using Shebini's structural analysis method to analyze the model described by Sebastian.

Sebastian in view of Shebini does not expressly teach that the errors determined using the corresponding surface group include the types recited by the claim.

Barequet teaches determining errors using a corresponding surface group, the errors including at least one of a change of a number of configuring surfaces, a change in direction or quantity of border lines, reversal of a direction of a surface, and a folding of a surface ["We describe an algorithm for repairing polyhedral CAD models that have errors in their B-REP. Errors like cracks, degeneracies, duplication, holes and overlaps are usually introduced in solid models due to imprecise arithmetic, model transformations, designer's fault, programming bugs, etc." (Barequet, abstract); "If the original orientation of facets is not consistent, we need to make the following modifications to our algorithm: Orient all the facets of each connected component *consistently with respect to other facets in the component..."* (Barequet, page 366, "4.2 Orientation Checking"); "The algorithm is also able to detect non-orientable surfaces while processing a "back-edge" in the depth-first order traversal. Back-edges are used to perform a consistency check between two facets whose respective orientations are already fixed. If the two orientation do not match, the component is non-orientable and the system reports the error as such." (Barequet, page 365, "2 Computing the Connected Components")].

Sebastian in view of Shebini and Barequet are analogous art because both are directed to CAD modeling.

It would have been obvious to a person of ordinary skill in the art at the time of Applicants' invention to combine the teachings of Sebastian in view of Shebini with Barequet as expressly motivated by Barequet to identify and correct problems in the CAD model ["File *formats like IGES ... DXF ... and STL ... (which is a de facto standard in the rapid*-prototyping industry) allow users to represent models as such soups of polygons... The collection of polygons is assumed to represent a complete model. Unfortunately this is often not the case. Typical problems include cracks (in the surface), degeneracies, duplication (of patches of the surface), *holes and overlaps, as shown in Figure 1... We present algorithms to eliminate dangling* geometry, T-joins, holes and cracks in a polygonal solid model, and generate consistent polygon-orientations." (Barequet, page 363, "1 Introduction")]. The combination could be achieved by using Barequet's algorithms in the system and method described by Sebastian in view of Shebini to identify and correct the same types of errors in Sebastian's CAD models. The combination would produce a system as described by Sebastian in view of Shebini but enhanced with the error identification and correction techniques taught by Barequet.

Therefore it would have been obvious to a person of ordinary skill in the art at the time of Applicants' invention to combine the teachings of Sebastian, Shebini, and Barequet to arrive at the invention specified in claim 13.

Regarding claim 14, Sebastian teaches:

A design support method which holds a series of design work histories as work history data in order for reuse and generates a shape by a computer according to the work history data

according to an instruction input to a processor [(abstract); (column 11, lines 32-49); (column 12, lines 3-11); (column 13, lines 44-46)], comprising the steps of:

Analyzing the work history data by sequentially reproducing unit work history data one by one upon input to the processor to extract the input work performed by a person in charge of work [(column 22, lines 21-65); (column 11, lines 32-49), (column 21, lines 50-55, etc.); Sebastian expressly provides an example of the feature templates being used sequentially, one by one, to construct an assembly (Sebastian, column 20, line 63 - column 23, line 8)];

Showing the extracted input work to the person in charge of work to request input of design support information;

when the design support information is input, recording the design support information in the work history data [(column 11, lines 32-49); (column 22, lines 21-65)]; and

Sebastian teaches to create a corresponding surface group ("macro feature") in accordance with user input ("macro feature templates") of a correspondence between the part shape models ("features") corresponding to the each unit work history data ("feature templates") [(Sebastian, column 12, lines 3-25); (Sebastian, column 23, lines 9-22)].

Sebastian teaches to determine, using the corresponding surface group, errors in the extracted input work arising from the second reference surface [See column 22, et seq., in particular: "The designer starts by instantiating the nominal wall feature and uses the add-on operation to provide "Fasten" functionality. In this example, the system searches for a function template using "Fasten" as the search criteria and provides the user with the boss feature. The user specifies the parameters for the boss such as dimension and positioning information. Based on the selection, the reasoning attributes of the feature template are evaluated and the system

examines the appropriate constraints. The constraints retrieve necessary additionally information from other feature templates, look-up tables and the material database 90. The constraints that pertain to the feature "boss" are evaluated, and it is found that the thickness of the boss is adequate to support the applied load. However, while considering the mold fill criteria, the thickness exceeds the manufacturer's recommendation (as retrieved from the manufacturer's external database) for the selected material. Depending on the constraint evaluation results, the user is notified through one of the following mechanisms: warning *messages, error messages and design change recommendations... In the boss example, the* system notifies the user that the "BOSS IS TOO THICK" and recommends a range of appropriate thickness values for the selected material that satisfies both the mold fill and the strength criteria." (column 22, line 18, et seq.)].

Sebastian does not expressly teach a database accumulating technical conditions as claimed, or that the errors determined using the corresponding surface group include the types recited by the claim.

Shebini teaches the database accumulating technical conditions, which are to be met by the part shape model to be created according to each work history data, in association with each work history data ["Turning to very particular structures, namely off-shore platforms, we see that they must be structurally adequate for operational and environmental loading, practical to construct, and be cost effective. The selection of a configuration is based on functional requirements and methods of installation." (Shebini, column 3, lines 60-65); "Once environmental loads are determined, they are combined with operational loads, and an estimate is made of the resulting pile mudline moments and axial forces." (Shebini, column 4, lines 33-

39); "Before the design solution of either the 3-dimensional "finite Element" analysis of the superstructure and jacket, or the beam-column analysis of the piling can be considered finished, it is necessary to determine compatible conditions at the pilehead-structure interface. These equilibrium conditions are usually obtained using an interaction analysis procedure which yields the combined response of the linear structure and its non-linear soil-pile foundation for nay imposed static load condition." (Shebini, column 4, lines 55-65); et cetera. Shebini provides numerous examples of the "technical conditions" that are accumulated in columns 3 and 4];

computing at least one technical characteristic value of the shape which is created based on the fetched work history data ["The equilibrium conditions determined from the interaction analysis are now imposed on the structural Model in combination with appropriate design loads, and a static analysis is performed. The internal member forces determined in this analysis are employed to check the stress levels in the members." (Shebini, column 4, line 65 - column 5, line 2)]; and

comparing the computed technical characteristic value with technical conditions related to work history data ["The stresses are compared to allowable stresses, as set forth in the design basis, and members resized accordingly." (Shebini, column 5, lines 2-5)];

wherein the computation of the at least one technical characteristic value comprises analyzing the strength of the one-piece shape model ["stress levels in the members" (Shebini, column 4, line 65 - column 5, line 5)].

Sebastian and Shebini are analogous art because both are drawn to structural modeling.

It would have been obvious to a person of ordinary skill in the art at the time of Applicants' invention to combine the teachings of Sebastian and Shebini as expressly motivated

by Shebini in order to predict the structural properties of the assembled product ["Nowadays, by using the Finite Element Method (FEM), stress analysts do not have to modify the problem to conform to available solutions. No matter how complex the shape or system of loads may be, the (FEM) treats a loaded structure as being built of numerous tiny connected substructures or elements as are shown in FIG. 8. Since these elements can be put together in virtually any fashion, they can be arranged in simulate exceedingly complex shapes. Thus, the (FEM) can be used to determine stresses for structural parts where no mathematically closed form solution exists." (Shebini, column 1, lines 25-35)]. The combination could be achieved by using Shebini's structural analysis method to analyze the model described by Sebastian.

Sebastian in view of Shebini does not expressly teach that the errors determined using the corresponding surface group include the types recited by the claim.

Barequet teaches determining errors using a corresponding surface group, the errors including at least one of a change of a number of configuring surfaces, a change in direction or quantity of border lines, reversal of a direction of a surface, and a folding of a surface ["We describe an algorithm for repairing polyhedral CAD models that have errors in their B-REP. Errors like cracks, degeneracies, duplication, holes and overlaps are usually introduced in solid models due to imprecise arithmetic, model transformations, designer's fault, programming bugs, etc." (Barequet, abstract); "If the original orientation of facets is not consistent, we need to make the following modifications to our algorithm: Orient all the facets of each connected component *consistently with respect to other facets in the component..."* (Barequet, page 366, "4.2 Orientation Checking"); "The algorithm is also able to detect non-orientable surfaces while processing a "back-edge" in the depth-first order traversal. Back-edges are used to perform a

consistency check between two facets whose respective orientations are already fixed. If the two orientation do not match, the component is non-orientable and the system reports the error as such." (Barequet, page 365, "2 Computing the Connected Components")].

Sebastian in view of Shebini and Barequet are analogous art because both are directed to CAD modeling.

It would have been obvious to a person of ordinary skill in the art at the time of Applicants' invention to combine the teachings of Sebastian in view of Shebini with Barequet as expressly motivated by Barequet to identify and correct problems in the CAD model ["File *formats like IGES ... DXF ... and STL ... (which is a de facto standard in the rapid*-prototyping industry) allow users to represent models as such soups of polygons... The collection of polygons is assumed to represent a complete model. Unfortunately this is often not the case. Typical problems include cracks (in the surface), degeneracies, duplication (of patches of the surface), *holes and overlaps, as shown in Figure 1... We present algorithms to el*iminate dangling geometry, T-joins, holes and cracks in a polygonal solid model, and generate consistent polygon-orientations." (Barequet, page 363, "1 Introduction")]. The combination could be achieved by using Barequet's algorithms in the system and method described by Sebastian in view of Shebini to identify and correct the same types of errors in Sebastian's CAD models. The combination would produce a system as described by Sebastian in view of Shebini but enhanced with the error identification and correction techniques taught by Barequet.

Therefore it would have been obvious to a person of ordinary skill in the art at the time of Applicants' invention to combine the teachings of Sebastian, Shebini, and Barequet to arrive at the invention specified in claim 14.

Regarding claim 15, Sebastian teaches:

A design support method, comprising the steps of:

Accumulating, using a computer, unit work history data which is formed by dividing a history of past design work into work units, comprising a first reference surface, determined for a design target and contains design support information related to input work among the design work; Showing the unit work history selectively upon receiving designation of the design target by the computer; Creating a shape, comprising a second reference surface, by sequentially reproducing the selected unit work history one by one; [See, e.g., (Sebastian, column 12, lines 3-25) describing "feature templates" which correspond to the claimed "work history data"; and (Sebastian, column 23, lines 9-22) describing "macro-features" and "macro-feature templates" which correspond to the claimed "combined shape model"; Sebastian expressly provides an example of the feature templates being used sequentially, one by one, to construct an assembly (Sebastian, column 20, line 63 - column 23, line 8)];

Providing the design support information related to input work when the input work is demanded while the unit work history is being reproduced [(abstract); (column 11, lines 32-49); (column 12, lines 3-11); (column 13, lines 44-46); (column 22, lines 21-65). This claim presents a combination of limitations recited by previous claims. These citations of the prior art are explained in more detail in the context of the previous claims.]; and

Sebastian teaches to create a corresponding surface group ("macro feature") in accordance with user input ("macro feature templates") of a correspondence between the part

shape models ("features") corresponding to the respective selected unit work history data ("feature templates") [(Sebastian, column 12, lines 3-25); (Sebastian, column 23, lines 9-22)].

Sebastian teaches to determine, using the corresponding surface group, errors in the combined shape model arising from the second reference surface [See column 22, et seq., in particular: "The designer starts by instantiating the nominal wall feature and uses the add-on operation to provide "Fasten" functionality. In this example, the system searches for a function template using "Fasten" as the search criteria and provides the user with the boss feature. The user specifies the parameters for the boss such as dimension and positioning information. Based on the selection, the reasoning attributes of the feature template are evaluated and the system examines the appropriate constraints. The constraints retrieve necessary additionally information from other feature templates, look-up tables and the material database 90. The constraints that pertain to the feature "boss" are evaluated, and it is found that the thickness of the boss is adequate to support the applied load. However, while considering the mold fill criteria, the thickness exceeds the manufacturer's recommendation (as retrieved from the manufacturer's external database) for the selected material. Depending on the constraint evaluation results, the user is notified through one of the following mechanisms: warning *messages, error messages and design change recommendations... In the boss example, the* system notifies the user that the "BOSS IS TOO THICK" and recommends a range of appropriate thickness values for the selected material that satisfies both the mold fill and the strength criteria." (column 22, line 18, et seq.)].

Sebastian does not expressly teach a database accumulating technical conditions as claimed, or that the errors determined using the corresponding surface group include the types recited by the claim.

Shebini teaches the accumulating, using the computer, technical conditions, which are to be met by a part shape model to be created according to each work history data, in association with each work history data ["Turning to very particular structures, namely off-shore platforms, we see that they must be structurally adequate for operational and environmental loading, practical to construct, and be cost effective. The selection of a configuration is based on functional requirements and methods of installation." (Shebini, column 3, lines 60-65); "Once environmental loads are determined, they are combined with operational loads, and an estimate is made of the resulting pile mudline moments and axial forces." (Shebini, column 4, lines 33-39); "Before the design solution of either the 3-dimensional "finite Element" analysis of the superstructure and jacket, or the beam-column analysis of the piling can be considered finished, it is necessary to determine compatible conditions at the pilehead-structure interface. These equilibrium conditions are usually obtained using an interaction analysis procedure which yields the combined response of the linear structure and its non-linear soil-pile foundation for nay imposed static load condition." (Shebini, column 4, lines 55-65); et cetera. Shebini provides numerous examples of the "technical conditions" that are accumulated in columns 3 and 4];

computing at least one technical characteristic value of the shape which is created based on the work history data ["The equilibrium conditions determined from the interaction analysis are now imposed on the structural Model in combination with appropriate design loads, and a static analysis is performed. The internal member forces determined in this analysis are

employed to check the stress levels in the members." (Shebini, column 4, line 65 - column 5, line 2)]; and

comparing the computed technical characteristic value with technical conditions related to unit work history data ["The stresses are compared to allowable stresses, as set forth in the design basis, and members resized accordingly." (Shebini, column 5, lines 2-5)];

wherein the computation of the at least one technical characteristic value comprises analyzing the strength of the shape ["stress levels in the members" (Shebini, column 4, line 65 - column 5, line 5)].

Sebastian and Shebini are analogous art because both are drawn to structural modeling.

It would have been obvious to a person of ordinary skill in the art at the time of Applicants' invention to combine the teachings of Sebastian and Shebini as expressly motivated by Shebini in order to predict the structural properties of the assembled product ["Nowadays, by using the Finite Element Method (FEM), stress analysts do not have to modify the problem to conform to available solutions. No matter how complex the shape or system of loads may be, the (FEM) treats a loaded structure as being built of numerous tiny connected substructures or elements as are shown in FIG. 8. Since these elements can be put together in virtually any fashion, they can be arranged in simulate exceedingly complex shapes. Thus, the (FEM) can be used to determine stresses for structural parts where no mathematically closed form solution exists." (Shebini, column 1, lines 25-35)]. The combination could be achieved by using Shebini's structural analysis method to analyze the model described by Sebastian.

Sebastian in view of Shebini does not expressly teach that the errors determined using the corresponding surface group include the types recited by the claim.

Barequet teaches determining errors using a corresponding surface group, the errors including at least one of a change of a number of configuring surfaces, a change in direction or quantity of border lines, reversal of a direction of a surface, and a folding of a surface ["We describe an algorithm for repairing polyhedral CAD models that have errors in their B-REP. Errors like cracks, degeneracies, duplication, holes and overlaps are usually introduced in solid models due to imprecise arithmetic, model transformations, designer's fault, programming bugs, etc." (Barequet, abstract); "If the original orientation of facets is not consistent, we need to make the following modifications to our algorithm: Orient all the facets of each connected component *consistently with respect to other facets in the component..."* (Barequet, page 366, "4.2 Orientation Checking"); "The algorithm is also able to detect non-orientable surfaces while processing a "back-edge" in the depth-first order traversal. Back-edges are used to perform a consistency check between two facets whose respective orientations are already fixed. If the two orientation do not match, the component is non-orientable and the system reports the error as such." (Barequet, page 365, "2 Computing the Connected Components")].

Sebastian in view of Shebini and Barequet are analogous art because both are directed to CAD modeling.

It would have been obvious to a person of ordinary skill in the art at the time of Applicants' invention to combine the teachings of Sebastian in view of Shebini with Barequet as expressly motivated by Barequet to identify and correct problems in the CAD model ["File *formats like IGES ... DXF ... and STL ... (which is a de facto standard in the rapid*-prototyping industry) allow users to represent models as such soups of polygons... The collection of polygons is assumed to represent a complete model. Unfortunately this is often not the case. Typical

problems include cracks (in the surface), degeneracies, duplication (of patches of the surface), *holes and overlaps, as shown in Figure 1... We present algorithms to eliminate dangling* geometry, T-joins, holes and cracks in a polygonal solid model, and generate consistent polygon-orientations." (Barequet, page 363, "1 Introduction")]. The combination could be achieved by using Barequet's algorithms in the system and method described by Sebastian in view of Shebini to identify and correct the same types of errors in Sebastian's CAD models. The combination would produce a system as described by Sebastian in view of Shebini but enhanced with the error identification and correction techniques taught by Barequet.

Therefore it would have been obvious to a person of ordinary skill in the art at the time of Applicants' invention to combine the teachings of Sebastian, Shebini, and Barequet to arrive at the invention specified in claim 15.

Regarding claim 16, Sebastian teaches wherein it is judged whether the work history to be reproduced conforms to predetermined guidance display conditions while the unit work history data is being reproduced by the computer and, if it conforms to the guidance display conditions, a guidance display determined in connection with the guide display conditions is performed (column 22, lines 21-65).

Regarding claim 17, Sebastian teaches a recording medium storing a design support program and being computer-readable, the design support program comprising:

A module holding a series of design work histories as a plurality of work history data, comprising a first reference surface, for creation of a part shape model, comprising a second

reference surface [(abstract); (column 11, lines 32-49); (column 12, lines 3-11); (column 13, lines 44-46)];

A module fetching at least two selected work history data from the held multiple work history data (column 22, lines 21-65); and

A module for outputting design work data for creating a one-piece shape model by sequentially reproducing unit work history data one by one and combining the at least two fetched work history data and connecting part shape models corresponding to the respective work history data [(column 12, lines 3-11); Sebastian provides an example of the feature templates being used sequentially, one by one, to construct an assembly (Sebastian, column 20, line 63 - column 23, line 8)]; and

a module creating a corresponding surface group ("macro feature") in accordance with user input ("macro feature templates") of a correspondence between the part shape models ("features") corresponding to the respective selected unit work history data ("feature templates") [(Sebastian, column 12, lines 3-25); (Sebastian, column 23, lines 9-22)].

Sebastian teaches to determine, using the corresponding surface group, errors in the combined shape model arising from the second reference surface [See column 22, et seq., in particular: "The designer starts by instantiating the nominal wall feature and uses the add-on operation to provide "Fasten" functionality. In this example, the system searches for a function template using "Fasten" as the search criteria and provides the user with the boss feature. The user specifies the parameters for the boss such as dimension and positioning information. Based on the selection, the reasoning attributes of the feature template are evaluated and the system examines the appropriate constraints. The constraints retrieve necessary additionally

information from other feature templates, look-up tables and the material database 90. The constraints that pertain to the feature "boss" are evaluated, and it is found that the thickness of the boss is adequate to support the applied load. However, while considering the mold fill criteria, the thickness exceeds the manufacturer's recommendation (as retrieved from the manufacturer's external database) for the selected material. Depending on the constraint evaluation results, the user is notified through one of the following mechanisms: warning messages, er*ror messages and design change recommendations... In the boss example, the* system notifies the user that the "BOSS IS TOO THICK" and recommends a range of appropriate thickness values for the selected material that satisfies both the mold fill and the strength criteria." (column 22, line 18, et seq.)].

Sebastian does not expressly teach a database accumulating technical conditions as claimed, or that the errors determined using the corresponding surface group include the types recited by the claim.

Shebini teaches a module accumulating technical conditions, which are to be met by a part shape model ["Turning to very particular structures, namely off-shore platforms, we see that they must be structurally adequate for operational and environmental loading, practical to construct, and be cost effective. The selection of a configuration is based on functional requirements and methods of installation." (Shebini, column 3, lines 60-65); "Once environmental loads are determined, they are combined with operational loads, and an estimate is made of the resulting pile mudline moments and axial forces." (Shebini, column 4, lines 33-39); "Before the design solution of either the 3-dimensional "finite Element" analysis of the superstructure and jacket, or the beam-column analysis of the piling can be considered finished,

it is necessary to determine compatible conditions at the pilehead-structure interface. These equilibrium conditions are usually obtained using an interaction analysis procedure which yields the combined response of the linear structure and its non-linear soil-pile foundation for nay imposed static load condition." (Shebini, column 4, lines 55-65); et cetera. Shebini provides numerous examples of the "technical conditions" that are accumulated in columns 3 and 4];

a module computing at least one technical characteristic value of the one-piece shape model which is created from the design work data ["The equilibrium conditions determined from the interaction analysis are now imposed on the structural Model in combination with appropriate design loads, and a static analysis is performed. The internal member forces determined in this analysis are employed to check the stress levels in the members." (Shebini, column 4, line 65 - column 5, line 2)]; and

a module comparing the computed technical characteristic value with technical conditions related to unit work history data which is the origin of the design work data ["The stresses are compared to allowable stresses, as set forth in the design basis, and members resized accordingly." (Shebini, column 5, lines 2-5)];

wherein the computation of the at least one technical characteristic value comprises analyzing the strength of the one-piece shape model ["stress levels in the members" (Shebini, column 4, line 65 - column 5, line 5)].

Sebastian and Shebini are analogous art because both are drawn to structural modeling.

It would have been obvious to a person of ordinary skill in the art at the time of Applicants' invention to combine the teachings of Sebastian and Shebini as expressly motivated by Shebini in order to predict the structural properties of the assembled product ["Nowadays, by

using the Finite Element Method (FEM), stress analysts do not have to modify the problem to conform to available solutions. No matter how complex the shape or system of loads may be, the (FEM) treats a loaded structure as being built of numerous tiny connected substructures or elements as are shown in FIG. 8. Since these elements can be put together in virtually any fashion, they can be arranged in simulate exceedingly complex shapes. Thus, the (FEM) can be used to determine stresses for structural parts where no mathematically closed form solution exists." (Shebini, column 1, lines 25-35)]. The combination could be achieved by using Shebini's structural analysis method to analyze the model described by Sebastian.

Sebastian in view of Shebini does not expressly teach that the errors determined using the corresponding surface group include the types recited by the claim.

Barequet teaches determining errors using a corresponding surface group, the errors including at least one of a change of a number of configuring surfaces, a change in direction or quantity of border lines, reversal of a direction of a surface, and a folding of a surface ["We describe an algorithm for repairing polyhedral CAD models that have errors in their B-REP. Errors like cracks, degeneracies, duplication, holes and overlaps are usually introduced in solid models due to imprecise arithmetic, model transformations, designer's fault, programming bugs, etc." (Barequet, abstract); "If the original orientation of facets is not consistent, we need to make the following modifications to our algorithm: Orient all the facets of each connected component consistently with resp*ect to other facets in the component..."* (Barequet, page 366, "4.2 Orientation Checking"); "The algorithm is also able to detect non-orientable surfaces while processing a "back-edge" in the depth-first order traversal. Back-edges are used to perform a consistency check between two facets whose respective orientations are already fixed. If the two

orientation do not match, the component is non-orientable and the system reports the error as such." (Barequet, page 365, "2 Computing the Connected Components")].

Sebastian in view of Shebini and Barequet are analogous art because both are directed to CAD modeling.

It would have been obvious to a person of ordinary skill in the art at the time of Applicants' invention to combine the teachings of Sebastian in view of Shebini with Barequet as expressly motivated by Barequet to identify and correct problems in the CAD model ["File *formats like IGES ... DXF ... and STL ... (which is a de facto standard in the rapid*-prototyping industry) allow users to represent models as such soups of polygons... The collection of polygons is assumed to represent a complete model. Unfortunately this is often not the case. Typical problems include cracks (in the surface), degeneracies, duplication (of patches of the surface), holes and overl*aps, as shown in Figure 1... We present algorithms to eliminate dangling* geometry, T-joins, holes and cracks in a polygonal solid model, and generate consistent polygon-orientations." (Barequet, page 363, "1 Introduction")]. The combination could be achieved by using Barequet's algorithms in the system and method described by Sebastian in view of Shebini to identify and correct the same types of errors in Sebastian's CAD models. The combination would produce a system as described by Sebastian in view of Shebini but enhanced with the error identification and correction techniques taught by Barequet.

Therefore it would have been obvious to a person of ordinary skill in the art at the time of Applicants' invention to combine the teachings of Sebastian, Shebini, and Barequet to arrive at the invention specified in claim 17.

Regarding claim 18, Sebastian teaches:

A recording medium storing a design support program and being computer-readable, the design support program comprising:

A module outputting work data for creating a shape model of a design target in order to create the shape model of the design target conforming to a desired standard shape [(column 11, lines 32-49); (column 12, lines 3-11)];

A module holding a history of design work performed with reference to a first standard shape, comprising a first reference surface, as a plurality of work history data [(column 11, lines 32-49); (column 12, lines 3-11)];

A module receiving designation of data about a second standard shape, comprising a second reference surface, which is a desired standard shape [(column 11, lines 32-49); (column 12, lines 3-11)];

A module fetching the selected multiple work history data from the held multiple work history data (column 22, lines 21-65); and

A module combining each of the fetched work history data, sequentially reproducing unit work history data one by one, reproducing design work with reference to the designated second standard shape for the design works performed with reference to the first standard shape among the design works contained in the work history data, and outputting work data corresponding to a one-piece shape model conforming to the second standard shape [(abstract); (column 11, lines 32-49); (column 12, lines 3-11); (column 13, lines 44-46); (column 22, lines 21-65). Sebastian provides an example of the feature templates being used sequentially, one by one, to construct an assembly (Sebastian, column 20, line 63 - column 23, line 8). This claim presents a combination

of limitations recited by previous claims. These citations of the prior art are explained in more detail in the context of the previous claims.]; and

a module creating a corresponding surface group ("macro feature") in accordance with user input ("macro feature templates") of a correspondence between the part shape models ("features") corresponding to the respective selected unit work history data ("feature templates") [(Sebastian, column 12, lines 3-25); (Sebastian, column 23, lines 9-22)]; and

a module determining, using the corresponding surface group, errors in the combined shape model arising from the second reference surface [See column 22, et seq., in particular: "The designer starts by instantiating the nominal wall feature and uses the add-on operation to provide "Fasten" functionality. In this example, the system searches for a function template using "Fasten" as the search criteria and provides the user with the boss feature. The user specifies the parameters for the boss such as dimension and positioning information. Based on the selection, the reasoning attributes of the feature template are evaluated and the system examines the appropriate constraints. The constraints retrieve necessary additionally information from other feature templates, look-up tables and the material database 90. The constraints that pertain to the feature "boss" are evaluated, and it is found that the thickness of the boss is adequate to support the applied load. However, while considering the mold fill criteria, the thickness exceeds the manufacturer's recommendation (as retrieved from the manufacturer's external database) for the selected material. Depending on the constraint evaluation results, the user is notified through one of the following mechanisms: warning messages, error messages and design chang*e recommendations... In the boss example, the* system notifies the user that the "BOSS IS TOO THICK" and recommends a range of appropriate

thickness values for the selected material that satisfies both the mold fill and the strength criteria." (column 22, line 18, et seq.)].

Sebastian does not expressly teach a database accumulating technical conditions as claimed, or that the errors determined using the corresponding surface group include the types recited by the claim.

Shebini teaches a module accumulating technical conditions, which are to be met by a part shape model ["Turning to very particular structures, namely off-shore platforms, we see that they must be structurally adequate for operational and environmental loading, practical to construct, and be cost effective. The selection of a configuration is based on functional requirements and methods of installation." (Shebini, column 3, lines 60-65); "Once environmental loads are determined, they are combined with operational loads, and an estimate is made of the resulting pile mudline moments and axial forces." (Shebini, column 4, lines 33-39); "Before the design solution of either the 3-dimensional "finite Element" analysis of the superstructure and jacket, or the beam-column analysis of the piling can be considered finished, it is necessary to determine compatible conditions at the pilehead-structure interface. These equilibrium conditions are usually obtained using an interaction analysis procedure which yields the combined response of the linear structure and its non-linear soil-pile foundation for nay imposed static load condition." (Shebini, column 4, lines 55-65); et cetera. Shebini provides numerous examples of the "technical conditions" that are accumulated in columns 3 and 4];

a module computing at least one technical characteristic value of the one-piece shape model which is created from the design work ["The equilibrium conditions determined from the interaction analysis are now imposed on the structural Model in combination with appropriate

design loads, and a static analysis is performed. The internal member forces determined in this analysis are employed to check the stress levels in the members." (Shebini, column 4, line 65 - column 5, line 2)]; and

a module comparing the computed technical characteristic value with technical conditions related to unit work history data which is the origin of the design work data ["The stresses are compared to allowable stresses, as set forth in the design basis, and members resized accordingly." (Shebini, column 5, lines 2-5)];

wherein the computation of the at least one technical characteristic value comprises analyzing the strength of the one-piece shape model ["stress levels in the members" (Shebini, column 4, line 65 - column 5, line 5)].

Sebastian and Shebini are analogous art because both are drawn to structural modeling.

It would have been obvious to a person of ordinary skill in the art at the time of Applicants' invention to combine the teachings of Sebastian and Shebini as expressly motivated by Shebini in order to predict the structural properties of the assembled product ["Nowadays, by using the Finite Element Method (FEM), stress analysts do not have to modify the problem to conform to available solutions. No matter how complex the shape or system of loads may be, the (FEM) treats a loaded structure as being built of numerous tiny connected substructures or elements as are shown in FIG. 8. Since these elements can be put together in virtually any fashion, they can be arranged in simulate exceedingly complex shapes. Thus, the (FEM) can be used to determine stresses for structural parts where no mathematically closed form solution exists." (Shebini, column 1, lines 25-35)]. The combination could be achieved by using Shebini's structural analysis method to analyze the model described by Sebastian.

Sebastian in view of Shebini does not expressly teach that the errors determined using the corresponding surface group include the types recited by the claim.

Barequet teaches determining errors using a corresponding surface group, the errors including at least one of a change of a number of configuring surfaces, a change in direction or quantity of border lines, reversal of a direction of a surface, and a folding of a surface ["We describe an algorithm for repairing polyhedral CAD models that have errors in their B-REP. Errors like cracks, degeneracies, duplication, holes and overlaps are usually introduced in solid models due to imprecise arithmetic, model transformations, designer's fault, programming bugs, etc." (Barequet, abstract); "If the original orientation of facets is not consistent, we need to make the following modifications to our algorithm: Orient all the facets of each connected component consistently with respect to other facets in the compon*ent..."* (Barequet, page 366, "4.2 Orientation Checking"); "The algorithm is also able to detect non-orientable surfaces while processing a "back-edge" in the depth-first order traversal. Back-edges are used to perform a consistency check between two facets whose respective orientations are already fixed. If the two orientation do not match, the component is non-orientable and the system reports the error as such." (Barequet, page 365, "2 Computing the Connected Components")].

Sebastian in view of Shebini and Barequet are analogous art because both are directed to CAD modeling.

It would have been obvious to a person of ordinary skill in the art at the time of Applicants' invention to combine the teachings of Sebastian in view of Shebini with Barequet as expressly motivated by Barequet to identify and correct problems in the CAD model ["File *formats like IGES ... DXF ... and STL ... (which is a de facto standard in the rapid*-prototyping

industry) allow users to represent models as such soups of polygons... The collection of polygons is assumed to represent a complete model. Unfortunately this is often not the case. Typical problems include cracks (in the surface), degeneracies, duplication (of patches of the surface), *holes and overlaps, as shown in Figure 1... We pre*sent algorithms to eliminate dangling geometry, T-joins, holes and cracks in a polygonal solid model, and generate consistent polygon-orientations." (Barequet, page 363, "1 Introduction")]. The combination could be achieved by using Barequet's algorithms in the system and method described by Sebastian in view of Shebini to identify and correct the same types of errors in Sebastian's CAD models. The combination would produce a system as described by Sebastian in view of Shebini but enhanced with the error identification and correction techniques taught by Barequet.

Therefore it would have been obvious to a person of ordinary skill in the art at the time of Applicants' invention to combine the teachings of Sebastian, Shebini, and Barequet to arrive at the invention specified in claim 18.

Regarding claim 19, Sebastian teaches:

A recording medium storing a design support program and being computer-readable, the design support program comprising:

A module holding a series of design work histories, comprising a first reference surface, to reuse as a work history data (column 13, lines 44-46);

A module analyzing the work history data by sequentially reproducing unit work history data one by one to extract input work performed by a person in charge of work [(column 22, lines 21-65); Sebastian expressly provides an example of the feature templates being used

sequentially, one by one, to construct an assembly (Sebastian, column 20, line 63 - column 23, line 8)];

A module showing the extracted input work, comprising a second reference surface, to the person in charge of work to receive input of design support information (column 22, lines 21-65); and

A module recording the design support information in the work history data when the design support information is input (column 22, lines 21-65); and

a module creating a corresponding surface group ("macro feature") in accordance with user input ("macro feature templates") of a correspondence between the part shape models ("features") corresponding to the respective selected unit work history data ("feature templates") [(Sebastian, column 12, lines 3-25); (Sebastian, column 23, lines 9-22)]; and

a module determining, using the corresponding surface group, errors in the combined shape model arising from the second reference surface [See column 22, et seq., in particular: "The designer starts by instantiating the nominal wall feature and uses the add-on operation to provide "Fasten" functionality. In this example, the system searches for a function template using "Fasten" as the search criteria and provides the user with the boss feature. The user specifies the parameters for the boss such as dimension and positioning information. Based on the selection, the reasoning attributes of the feature template are evaluated and the system examines the appropriate constraints. The constraints retrieve necessary additionally information from other feature templates, look-up tables and the material database 90. The constraints that pertain to the feature "boss" are evaluated, and it is found that the thickness of the boss is adequate to support the applied load. However, while considering the mold fill

criteria, the thickness exceeds the manufacturer's recommendation (as retrieved from the manufacturer's external database) for the selected material. Depending on the constraint evaluation results, the user is notified through one of the following mechanisms: warning *messages, error messages and design change recommendations... In the boss example, the* system notifies the user that the "BOSS IS TOO THICK" and recommends a range of appropriate thickness values for the selected material that satisfies both the mold fill and the strength criteria." (column 22, line 18, et seq.)].

Sebastian does not expressly teach a database accumulating technical conditions as claimed, or that the errors determined using the corresponding surface group include the types recited by the claim.

Shebini teaches a module accumulating technical conditions, which are to be met by a part shape model to be created according to each work history data, in association with each work history data ["Turning to very particular structures, namely off-shore platforms, we see that they must be structurally adequate for operational and environmental loading, practical to construct, and be cost effective. The selection of a configuration is based on functional requirements and methods of installation." (Shebini, column 3, lines 60-65); "Once environmental loads are determined, they are combined with operational loads, and an estimate is made of the resulting pile mudline moments and axial forces." (Shebini, column 4, lines 33-39); "Before the design solution of either the 3-dimensional "finite Element" analysis of the superstructure and jacket, or the beam-column analysis of the piling can be considered finished, it is necessary to determine compatible conditions at the pilehead-structure interface. These equilibrium conditions are usually obtained using an interaction analysis procedure which yields

the combined response of the linear structure and its non-linear soil-pile foundation for nay imposed static load condition." (Shebini, column 4, lines 55-65); et cetera. Shebini provides numerous examples of the "technical conditions" that are accumulated in columns 3 and 4];

a module computing at least one technical characteristic value of the extracted input work which is created from the work history data ["The equilibrium conditions determined from the interaction analysis are now imposed on the structural Model in combination with appropriate design loads, and a static analysis is performed. The internal member forces determined in this analysis are employed to check the stress levels in the members." (Shebini, column 4, line 65 - column 5, line 2)]; and

a module comparing the computed technical characteristic value with technical conditions related to work history data ["The stresses are compared to allowable stresses, as set forth in the design basis, and members resized accordingly." (Shebini, column 5, lines 2-5)];

wherein the computation of the at least one technical characteristic value comprises analyzing the strength of the extracted input work ["stress levels in the members" (Shebini, column 4, line 65 - column 5, line 5)].

Sebastian and Shebini are analogous art because both are drawn to structural modeling.

It would have been obvious to a person of ordinary skill in the art at the time of Applicants' invention to combine the teachings of Sebastian and Shebini as expressly motivated by Shebini in order to predict the structural properties of the assembled product ["Nowadays, by using the Finite Element Method (FEM), stress analysts do not have to modify the problem to conform to available solutions. No matter how complex the shape or system of loads may be, the (FEM) treats a loaded structure as being built of numerous tiny connected substructures or

elements as are shown in FIG. 8. Since these elements can be put together in virtually any fashion, they can be arranged in simulate exceedingly complex shapes. Thus, the (FEM) can be used to determine stresses for structural parts where no mathematically closed form solution exists." (Shebini, column 1, lines 25-35)]. The combination could be achieved by using Shebini's structural analysis method to analyze the model described by Sebastian.

Sebastian in view of Shebini does not expressly teach that the errors determined using the corresponding surface group include the types recited by the claim.

Barequet teaches determining errors using a corresponding surface group, the errors including at least one of a change of a number of configuring surfaces, a change in direction or quantity of border lines, reversal of a direction of a surface, and a folding of a surface ["We describe an algorithm for repairing polyhedral CAD models that have errors in their B-REP. Errors like cracks, degeneracies, duplication, holes and overlaps are usually introduced in solid models due to imprecise arithmetic, model transformations, designer's fault, programming bugs, etc." (Barequet, abstract); "If the original orientation of facets is not consistent, we need to make the following modifications to our algorithm: Orient all the facets of each connected component *consistently with respect to other facets in the component..."* (Barequet, page 366, "4.2 Orientation Checking"); "The algorithm is also able to detect non-orientable surfaces while processing a "back-edge" in the depth-first order traversal. Back-edges are used to perform a consistency check between two facets whose respective orientations are already fixed. If the two orientation do not match, the component is non-orientable and the system reports the error as such." (Barequet, page 365, "2 Computing the Connected Components")].

Sebastian in view of Shebini and Barequet are analogous art because both are directed to CAD modeling.

It would have been obvious to a person of ordinary skill in the art at the time of Applicants' invention to combine the teachings of Sebastian in view of Shebini with Barequet as expressly motivated by Barequet to identify and correct problems in the CAD model ["File *formats like IGES ... DXF ... and STL ... (which is a de facto standard in the rapid*-prototyping industry) allow users to represent models as such soups of polygons... The collection of polygons is assumed to represent a complete model. Unfortunately this is often not the case. Typical problems include cracks (in the surface), degeneracies, duplication (of patches of the surface), *holes and overlaps, as shown in Figure 1... We present algorithms to eliminate dang*ling geometry, T-joins, holes and cracks in a polygonal solid model, and generate consistent polygon-orientations." (Barequet, page 363, "1 Introduction")]. The combination could be achieved by using Barequet's algorithms in the system and method described by Sebastian in view of Shebini to identify and correct the same types of errors in Sebastian's CAD models. The combination would produce a system as described by Sebastian in view of Shebini but enhanced with the error identification and correction techniques taught by Barequet.

Therefore it would have been obvious to a person of ordinary skill in the art at the time of Applicants' invention to combine the teachings of Sebastian, Shebini, and Barequet to arrive at the invention specified in claim 19.

Regarding claim 20, Sebastian teaches:

A recording medium storing a design support program and being computer-readable, the design support program comprising:

A module accumulating unit work history data which is formed by dividing a history of past design work into work units, comprising a first reference surface, determined for a design target and contains design support information related to input work among the design work [(abstract); (column 11, lines 32-49); (column 12, lines 3-11); (column 13, lines 44-46)];

A module selectively showing the unit work history upon receiving designation of the design target (column 22, lines 21-65);

A module creating a shape, comprising a second reference surface, by sequentially reproducing the selected unit work history one by one [(column 11, lines 32-49); (column 12, lines 3-11); Sebastian provides an example of the feature templates being used sequentially, one by one, to construct an assembly (Sebastian, column 20, line 63 - column 23, line 8)]; and

A module providing design support information related to an input work when the input work is demanded while the unit work history is being reproduced (column 16, lines 19-47); and

a module creating a corresponding surface group ("macro feature") in accordance with user input ("macro feature templates") of a correspondence between the part shape models ("features") corresponding to the respective selected unit work history data ("feature templates") [(Sebastian, column 12, lines 3-25); (Sebastian, column 23, lines 9-22)]; and

a module determining, using the corresponding surface group, errors in the combined shape model arising from the second reference surface [See column 22, et seq., in particular: "The designer starts by instantiating the nominal wall feature and uses the add-on operation to provide "Fasten" functionality. In this example, the system searches for a function template

using "Fasten" as the search criteria and provides the user with the boss feature. The user specifies the parameters for the boss such as dimension and positioning information. Based on the selection, the reasoning attributes of the feature template are evaluated and the system examines the appropriate constraints. The constraints retrieve necessary additionally information from other feature templates, look-up tables and the material database 90. The constraints that pertain to the feature "boss" are evaluated, and it is found that the thickness of the boss is adequate to support the applied load. However, while considering the mold fill criteria, the thickness exceeds the manufacturer's recommendation (as retrieved from the manufacturer's external database) for the selected material. Depending on the constraint evaluation results, the user is notified through one of the following mechanisms: warning *messages, error messages and design change recommendations... In the boss example, the* system notifies the user that the "BOSS IS TOO THICK" and recommends a range of appropriate thickness values for the selected material that satisfies both the mold fill and the strength criteria." (column 22, line 18, et seq.)].

Sebastian does not expressly teach a database accumulating technical conditions as claimed, or that the errors determined using the corresponding surface group include the types recited by the claim.

Shebini teaches a module accumulating technical conditions, which are to be met by a part shape model to be created according to each unit work history data, in association with each unit work history data ["Turning to very particular structures, namely off-shore platforms, we see that they must be structurally adequate for operational and environmental loading, practical to construct, and be cost effective. The selection of a configuration is based on functional

requirements and methods of installation." (Shebini, column 3, lines 60-65); "Once environmental loads are determined, they are combined with operational loads, and an estimate is made of the resulting pile mudline moments and axial forces." (Shebini, column 4, lines 33-39); "Before the design solution of either the 3-dimensional "finite Element" analysis of the superstructure and jacket, or the beam-column analysis of the piling can be considered finished, it is necessary to determine compatible conditions at the pilehead-structure interface. These equilibrium conditions are usually obtained using an interaction analysis procedure which yields the combined response of the linear structure and its non-linear soil-pile foundation for nay imposed static load condition." (Shebini, column 4, lines 55-65); et cetera. Shebini provides numerous examples of the "technical conditions" that are accumulated in columns 3 and 4];

a module computing at least one technical characteristic value of the shape which is created from the work history data ["The equilibrium conditions determined from the interaction analysis are now imposed on the structural Model in combination with appropriate design loads, and a static analysis is performed. The internal member forces determined in this analysis are employed to check the stress levels in the members." (Shebini, column 4, line 65 - column 5, line 2)]; and

a module comparing the computed technical characteristic value with technical conditions related to work history data ["The stresses are compared to allowable stresses, as set forth in the design basis, and members resized accordingly." (Shebini, column 5, lines 2-5)];

wherein the computation of the at least one technical characteristic value comprises analyzing the strength of the shape ["stress levels in the members" (Shebini, column 4, line 65 - column 5, line 5)].

Sebastian and Shebini are analogous art because both are drawn to structural modeling.

It would have been obvious to a person of ordinary skill in the art at the time of Applicants' invention to combine the teachings of Sebastian and Shebini as expressly motivated by Shebini in order to predict the structural properties of the assembled product ["Nowadays, by using the Finite Element Method (FEM), stress analysts do not have to modify the problem to conform to available solutions. No matter how complex the shape or system of loads may be, the (FEM) treats a loaded structure as being built of numerous tiny connected substructures or elements as are shown in FIG. 8. Since these elements can be put together in virtually any fashion, they can be arranged in simulate exceedingly complex shapes. Thus, the (FEM) can be used to determine stresses for structural parts where no mathematically closed form solution exists." (Shebini, column 1, lines 25-35)]. The combination could be achieved by using Shebini's structural analysis method to analyze the model described by Sebastian.

Sebastian in view of Shebini does not expressly teach that the errors determined using the corresponding surface group include the types recited by the claim.

Barequet teaches determining errors using a corresponding surface group, the errors including at least one of a change of a number of configuring surfaces, a change in direction or quantity of border lines, reversal of a direction of a surface, and a folding of a surface ["We describe an algorithm for repairing polyhedral CAD models that have errors in their B-REP. Errors like cracks, degeneracies, duplication, holes and overlaps are usually introduced in solid models due to imprecise arithmetic, model transformations, designer's fault, programming bugs, etc." (Barequet, abstract); "If the original orientation of facets is not consistent, we need to make the following modifications to our algorithm: Orient all the facets of each connected component

consistently with respect to other facets in the component..." (Barequet, page 366, "4.2 Orientation Checking"); "The algorithm is also able to detect non-orientable surfaces while processing a "back-edge" in the depth-first order traversal. Back-edges are used to perform a consistency check between two facets whose respective orientations are already fixed. If the two orientation do not match, the component is non-orientable and the system reports the error as such." (Barequet, page 365, "2 Computing the Connected Components")].

Sebastian in view of Shebini and Barequet are analogous art because both are directed to CAD modeling.

It would have been obvious to a person of ordinary skill in the art at the time of Applicants' invention to combine the teachings of Sebastian in view of Shebini with Barequet as expressly motivated by Barequet to identify and correct problems in the CAD model ["File *formats like IGES ... DXF ... and STL ... (which is a de facto standard in the rapid*-prototyping industry) allow users to represent models as such soups of polygons... The collection of polygons is assumed to represent a complete model. Unfortunately this is often not the case. Typical problems include cracks (in the surface), degeneracies, duplication (of patches of the surface), *holes and overlaps, as shown in Figure 1... We present algorithms to eliminate dangling* geometry, T-joins, holes and cracks in a polygonal solid model, and generate consistent polygon-orientations." (Barequet, page 363, "1 Introduction")]. The combination could be achieved by using Barequet's algorithms in the system and method described by Sebastian in view of Shebini to identify and correct the same types of errors in Sebastian's CAD models. The combination would produce a system as described by Sebastian in view of Shebini but enhanced with the error identification and correction techniques taught by Barequet.

Therefore it would have been obvious to a person of ordinary skill in the art at the time of Applicants' invention to combine the teachings of Sebastian, Shebini, and Barequet to arrive at the invention specified in claim 20.

Regarding claim 21, Sebastian teaches:

The recording medium being computer-readable according to claim 20, wherein:

The design support program stored in the recording medium further includes a module judging whether the work history to be reproduced agrees with predetermined guidance display conditions while the unit work history is being reproduced and, if the work history agrees with the guidance display conditions, implements a guidance display determined in connection with the conditions [(column 16, lines 19-47); (column 22, lines 21-65)].

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Jason Proctor whose telephone number is (571) 272-3713. The examiner can normally be reached between 8:30 am-4:30 pm M-F.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Paul Rodriguez can be reached at (571) 272-3753. The fax phone number for the organization where this application or proceeding is assigned is (571) 273-8300.

Any inquiry of a general nature or relating to the status of this application should be directed to the TC 2100 Group receptionist: 571-272-2100. Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR)

system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

/Jason Proctor/
Primary Examiner, Art Unit 2123

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